JANUARY 2012

BEAUTY OF THE PYRAMIDS
PG 45

INDIAN BEACHES
PG 32

Science Reporter

A CSIR PUBLICATION

Women in Science

- Women in Space
- Female Science Stars
- Women as Science Communicators
- Women's Movement & Technology
- Interview with Prof. Geetha Bali
- Quiz on Women Scientists

Science Reporter

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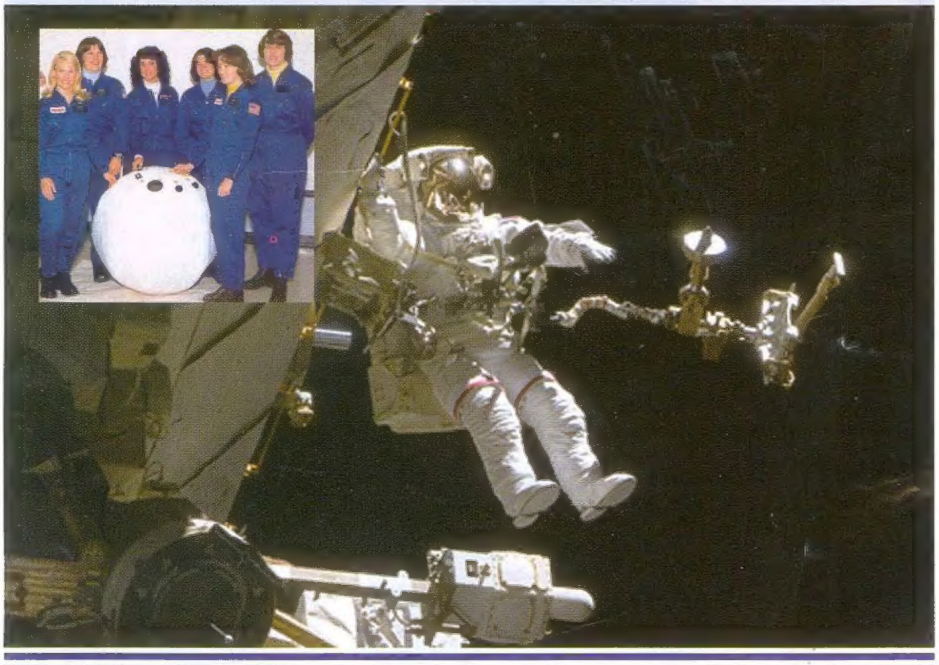

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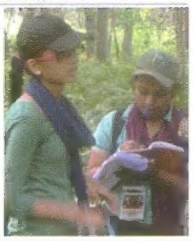


IN CONVERSATION

Interview with Prof. Geetha Bali, Vice Chancellor, Karnataka State Women's University, Bijapur and General President of the 99th Indian Science Congress 18

Science Reporter

Paradoxes of Life

The July 2011 issue of *Science Reporter* was memorable in many respects, but one article by Deepak Joshi, **Tracking Down Early Evolution of Life**, was unique. Very briefly the writer touched upon the beautiful and mysterious nature

of evolution of life in our globe. Mr Joshi showed that the first primitive cell (prokaryote) appeared on earth some 3.50 billion years (by) ago. It took about 1.50 by for that cell to modernize (Eukaryote) and another 300 million years for the eukaryote to multiply (multicellular organism. After appearance of the first multicellular organism it took another 1.2 by for life to take up its present form! Amazing it may sound, but evolution is really a slow process indeed!

But what is life? What is an organism? How do they differ? Or, how do they differ from an inanimate one? Scientists are still not sure about the answers. Some funny paradoxes may be cited in this context. When an ant is cut into two parts, the head part may eat and the rest part may walk! They are definitely living but are they organisms? Similarly, the life span of an amoeba is about two days but that of well-preserved human blood outside the body is about 90 days. Both are living but human blood is not an organism. Again, a freshly cut piece of flesh from a living goat is not an organism but the goat may be recreated from it through cloning.

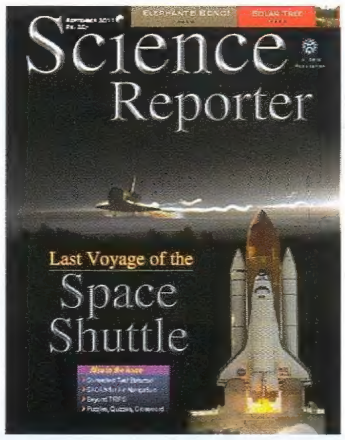
The DNA strand inside a living cell is the true king—outside it is nothing but a complex organic molecule. But surprisingly inside the cell the structure of DNA does not change. Then, if the key of life is in the DNA molecule, it must be distributed in every atom of the DNA molecule, because without its constituents, there is no DNA. How does a particular arrangement of atoms acquire the property of life?

Apart from matter and energy (which are different forms of the same thing) is there an entity in this universe named life? Does Life exist in every fundamental particle in quantized form? Is there an Eigen value that must be attained by a very specific chemical combination of elements for animation? Some day certainly the answers will come and artificial life will be created in the lab. We will have to wait patiently.

Sudhamoy Banerjee
Burdwan (W.B.)

Window of Astronomy

The September article, **Legacy of the Space Shuttle,** was such an attractive cover story that not just my classmates but also my juniors were eager to explore the world through the windows of astronomy provided by *Science Reporter*. On behalf of all the readers, I would like to thank this amazing magazine that enables us to maintain our confidence level. *Science Reporter* acts as a source of great inspiration for many young scientific minds



helping them in science competitions. I am highly obliged to my sir Mr P.S. Rawat, who directed me towards the gleeful world of *Science Reporter*.

Nancy Asija
J.N.V. Patiala
nancyorsonal@gmail.com

Fueling Ambition

I would like to thank the author of the article **The Enigma of**

Dark Matter (October 2011), Mr P.K. Mukherjee, for giving such an informative article. The article has truly informed and fascinated me and also further fueled my ambition to become an astrophysicist.

Sayan Chowdhury
Kolkata

Corrigendum

In the article "Chemistry Education in the 21st Century" (December 2011), the last page of the article could not be published due to an inadvertent error. Therefore, the article is being published again in this issue.

Corrigendum

In the Article "**The Best Tennis player ever**" (Dec'11) a Table placed below was missed.

Top 30 players in the history of tennis, using Radicchi's Prestige Score.

Rank & Player	Career
1 Jimmy Connors	1970-1996
2 Ivan Lendl	1978-1994
3 John McEnroe	1976-1994
4 Guillermo Vilas	1969-1999
5 Andre Agassi	1986-2006
6 Stefan Edberg	1982-1996
7 Roger Federer	1998-2010
8 Pete Sampras	1988-2002
9 Ilie Nastase	1968-1985
10 Bjorn Borg	1971-1993
11 Boris Becker	1983-1999
12 Arthur Ashe	1968-1979
13 Brian Gottfried	1970-1984
14 Stan Smith	1968-1985
15 Manuel Orantes	1968-1984
16 Michael Chang	1987-2003
17 Roscoe Tanner	1969-1985
18 Eddie Dibbs	1971-1984
19 Harold Solomon	1971-1991
20 Tom Okker	1968-1981
21 Mats Wilander	1980-1996
22 Goran Ivanisevic	1988-2004
23 Vitas Gerulaitis	1971-1986
24 Rafael Nadal	2002-2010
25 Raul Ramirez	1970-1983
26 John Newcombe	1968-1981
27 Ken Rosewall	1968-1980
28 Yevgeny Kafelnikov	1992-2003
29 Andy Roddick	2000-2010
30 Thomas Muster	1984-1999

Science Reporter
Wishes
Its Readers
A Very
Happy and
Prosperous
New Year
2012

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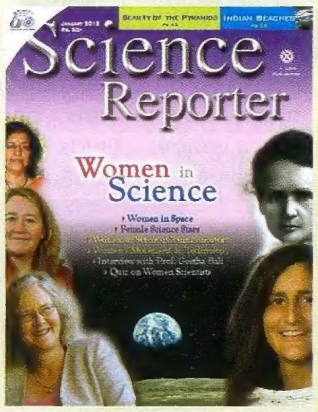
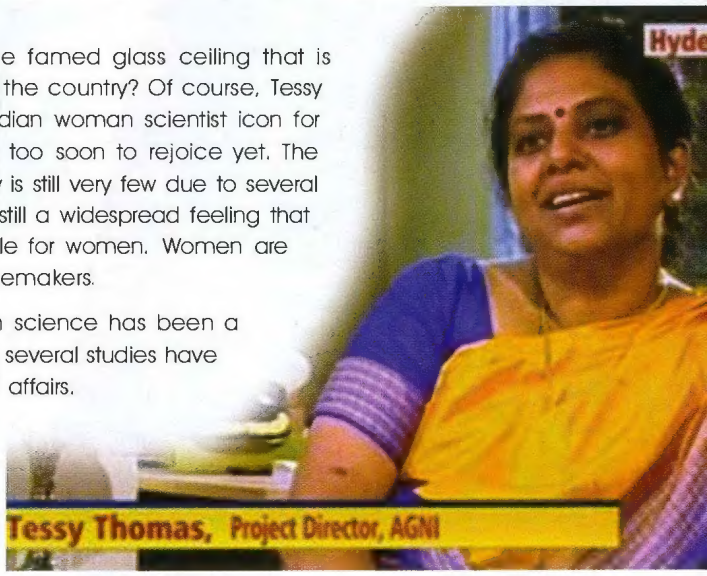


COVER DESIGN
NEERU SHARMA

ENCOURAGING WOMEN IN SCIENCE

After the "Missile Man"—former President of India Dr A.P.J. Abdul Kalam—India has its own "Missile Woman". Tessy Thomas, the 48-year-old first-ever woman director of an Indian missile project along with her team successfully tested the new-generation Agni-IV missile on November 15 breaking new records for India by hitting a target 3,000 km away from the Balasore test range in the Orissa coast. This made Agni-IV the first Indian missile to cross the equator and hit a target in the southern hemisphere.



Has Tessy Thomas finally blasted the famed glass ceiling that is supposed to exist for women scientists in the country? Of course, Tessy Thomas has emerged as a prominent Indian woman scientist icon for women in the country. But perhaps, it is too soon to rejoice yet. The number of women scientists in the country is still very few due to several cultural and sociological barriers. There is still a widespread feeling that arts and social sciences are more suitable for women. Women are also expected to be primarily good homemakers.

In fact, the issue of fewer women in science has been a matter of concern worldwide for long. And several studies have pointed at various reasons for this state of affairs.

A 1997 study of research funding by the Swedish Medical Research Council (MRC) discovered gender bias in the way research awards were made. It showed that women had to be about 2.2 times more productive than their male counterparts to be as successful in securing financial support. The study startled and galvanized many institutions into action. It could not be assumed any longer that an absence of women in science was due to women themselves, rather than the institutions to which they belonged.

Data from Canada and the USA also show that far fewer women are successfully engaged in scientific enterprises than would have been expected given the increasing numbers of women in the workforce. A research report by AAUW (American Association of University Women) has pointed to environmental and social barriers – including stereotypes, gender bias and the climate of science and engineering departments in colleges and universities – that continue to block women's participation and progress in science, technology, engineering, and math. The report found ample evidence of continuing cultural bias.

An Indian study has also found that women's careers in science are cut short more often not because of family pressures, but largely from a systemic bias at the institutional level. The report titled "Trained scientific women power: How much are we losing and why?" found that the majority of unemployed women PhDs (66.%) cited not getting job as the primary reason for not working, while "family reasons" was cited by only 3.3%.

As with all other professions, women face problems due to social attitudes, the time they have to take off to start family, social pressures, unfair gender bias in hiring policies and so on. But it should be realized that the absence of women from science implies a formidable underused human resource.

It is imperative therefore to bring about a change in societal attitudes that will favour science careers for women and also put in place women-friendly practices and hiring policies.

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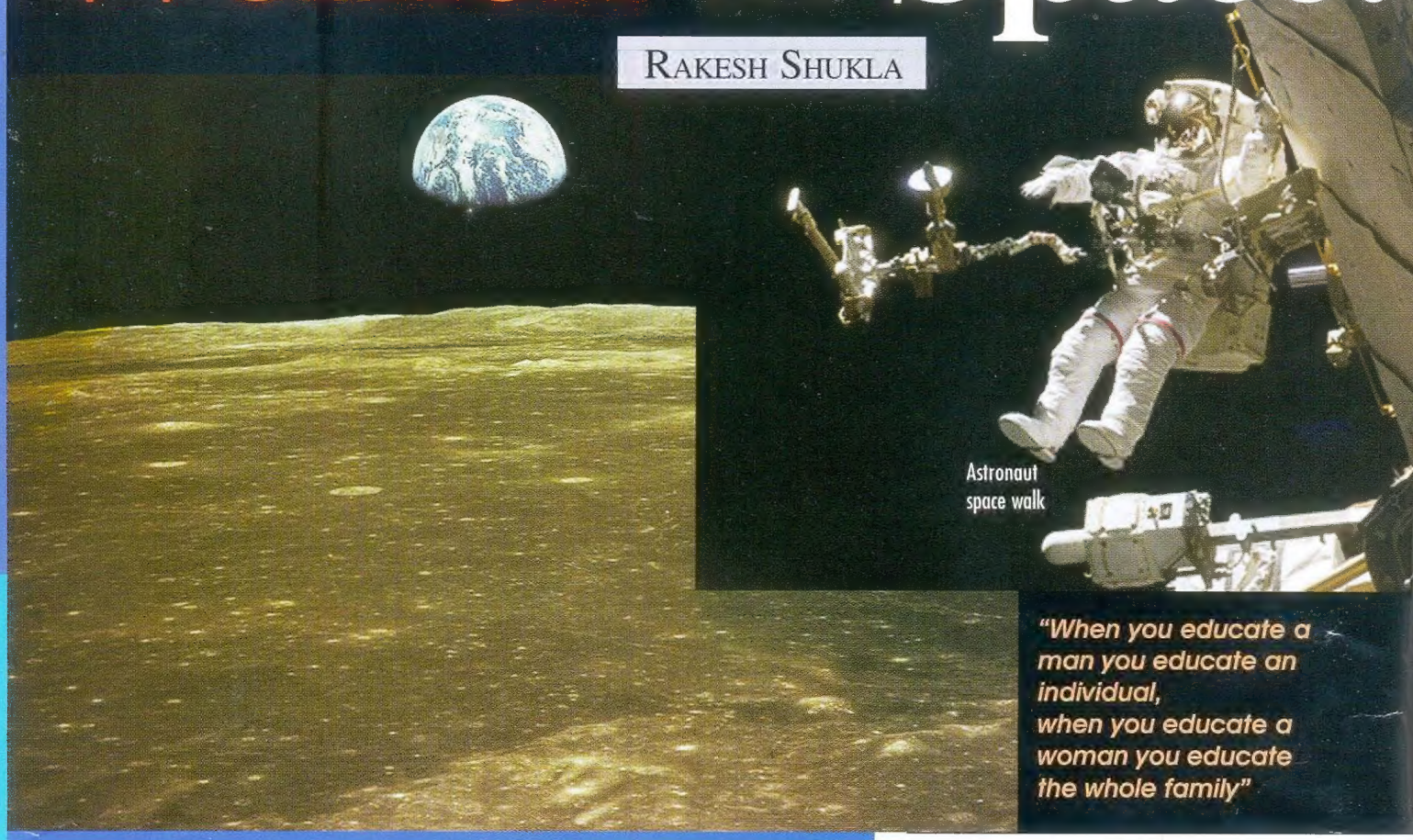
Women in Space!

RAKESH SHUKLA



Astronaut space walk

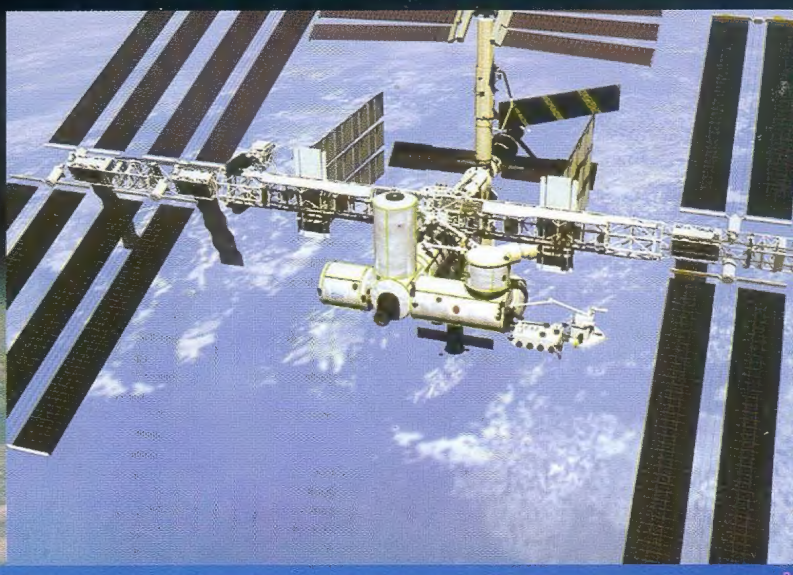
"When you educate a man you educate an individual, when you educate a woman you educate the whole family"

The contributions of women to the history of space exploration have inspired generations of young girls to dream of becoming astronauts. Women astronauts also hold an edge biologically over their male counterparts.

WOMAN is a mother, a daughter, a sister and a wife. In fact, woman is the root of the family. Women have been working on an equal footing with their male counterparts and contributing to various fields like engineering, medicine, education or

Astronaut Peggy Whitson floating in the ISS lab

Eileen Collins--first woman to command a shuttle crew



Till January 2011, women from seven different countries had gone into space and these women have passed a total of 2957 days and 6 hours in space, collectively.

politics. Even in the much demanding and tough field of space exploration women have made tremendous contributions. Most of these women went unnoticed even though they played an important role in the history of space exploration.

It has been shown that biologically a female can do better in space exploration. In the environment of space, a woman, because of her nature, can adapt to various factors such as heat, spacecraft tremors etc better compared to a man. A woman is less prone to space radiations also. And a woman weighing 120 pounds consumes less oxygen compared to a man of 160 pounds. The lesser weight of women is itself a significant advantage in the environment of space.

Men are also disadvantaged because they retain much higher levels of iron in the body than women, particularly in space, and this can reach toxic levels. Men in their thirties and forties are much more likely to develop the first signs of heart disease, a condition exacerbated by space travel. Women are protected from this by their comparatively high levels of oestrogen.

Yet, there were several women who never got a chance to enter into space despite having passed the most stringent of tests. In 1961, 13 women aviators were extensively tested for their physical and psychological tolerance to the then-unknown rigors of space flight. The first woman to go through the Mercury 13 astronaut test was Jerrie Cobb. A 28-year-old pilot, with three world records, and 7,000 hours of flying time, Jerrie Cobb had ice water injected into her ears to test her balance. She, as well as Wally Funk, were the only women who successfully completed the tests used for the original seven Mercury astronauts. In spite of these women completing all three of the phases, and 11 other women completing Phase I, they would never get the chance to go into orbit.

The year 1950 is of great significance because the year marked the beginning of a new era of space age with the launch of *Sputnik*. Those were times when no one could even dream of humans going out into space much less coming back unscathed. But soon after Yuri Gagarin had stepped into space, Valentina Tereshkova became the first woman to enter space paving the way for many more women to brave the harsh conditions of space in the years to come.

After that there was no looking back for women in the field of space exploration. As on January 2011, around 520 persons had gone into space through 282 manned space flights. Of these 56 are women from various countries like Russia, USA, Canada, France, Japan, Korea and Britain.

Women have played a major role in the Space Shuttle mission's assembly of MIR and International Space Station (ISS), deployment of space telescopes and repairs of Hubble telescope. In shuttle and space station missions they have played the role of commander, pilot, mission specialist and payload specialist. Eileen Collins was the first space shuttle commander and Peggy Whitson was the first International Space Station Commander.

For carrying out repair works on space stations, 11 women have performed 29 space walks (also called Extravehicular Activity—EVA) amounting to 188 hours and 10 minutes duration. Sunita Williams stayed in space (at one stretch) for 194 days 18 hours and Peggy Whitson had a total stay in space (through all her space flights) of

376 days and 17 hours. A total of 56 women from 7 countries through a total 128 space flights have passed a total time of 2957 days and 6 hours (roughly 8 years) in space.

Women throughout the world are contributing on an equal footing as men for the success of various space missions. In the field of space exploration, women have excelled in various programmes be it Operational Launch Vehicles, state-of-the-art remote sensing civilian satellite constellations, multipurpose communication satellite constellation, a set of identified space applications using remotely sensed data and satellite communication network.

India even plans to send women into space. It is expected to be a long drawn procedure to pick the best among the aspirants and put them through a rigorous training schedule to help them survive the extremely tough conditions in space. The entire process will take more than three years. The journey into space on board a two-seat capsule is scheduled for 2014. The capsule would be designed to cruise in space, 400 km from earth, for a week after which it will splash into the Bay of Bengal. ISRO has signed a pact with Roskosmos, the Russia federal space agency, for help in selection and training of the crew.

Women's Entry into Space

The first woman in the world to enter space was the Russian Valentina Tereshkova who went to space on 16 June 1963 aboard *Vostok-6* spacecraft. Tereshkova who worked as a textile mill worker enjoyed parachute jumping as a hobby. The second woman to go into space was again a Russian—Svetlana Svetskaya—who went into space on 19 August 1982. Her destination was the Soviet Space Station Salyut-7.

The US took a much longer time in sending the first American woman to space. It was Sally Ride from the US who went into space on 18 June 1983 (almost 20 years after Valentina Tereshkova went). The first woman to go into space two times was Svetlana Svetskaya (from Soviet Union) and first woman from US to go into space two times was Sally Ride. Another American woman Judith Resnik went into space after Sally Ride. Dr. Tamara Jernigan was the payload commander on the first Shuttle flight dedicated in its entirety to investigating how the body adapts to micro-gravity.

Women in Important Space Missions

1. Space Shuttle: The first woman commander and pilot of a shuttle mission was Eileen Collins. She has commanded shuttle missions twice. The second woman commander of a shuttle mission was Pamela Melroy.

2. International Space Station:

a. Peggy Whitson is the first and the only woman who has been the commander of ISS (International Space Station), in the year 2008.

b. The first woman to go to the International Space Station was Susan Helms who lived there from March 2001 to August 2001.

c. Till date some 31 women have visited the International Space Station and done assembly and maintenance works.

3. Space Tourist: The first woman space tourist was Anouseh Ansari (of Iranian origin and now a US citizen).

4. MIR: Dr. Shannon Lucid spent 188 days on the Russian space station MIR.

5. Maximum number of women in orbit: The presence of four women in space at one time during the space shuttle mission STS-131 in 2010 set a record for the most women in space at the same time. These women were Dorothy Metcalf-Lidenburger, Stephanie Wilson, Naoko Yamazaki and Tracy Caldwell. In another instance, during a space shuttle mission, nearly 2/3rd of the flight control team were women including the launch commentator, ascent commentator, the flight director and communicator between crew and mission control.

The first woman from Canada to reach space was Roberta Bonder, from France Cloudie Haignere, from Japan Chiaki Mukai, from Britain Helen Sharman and from South Korea Yi Soyeon. The first Japanese mother in space was Naoko Yamazaki.

Stay in Space

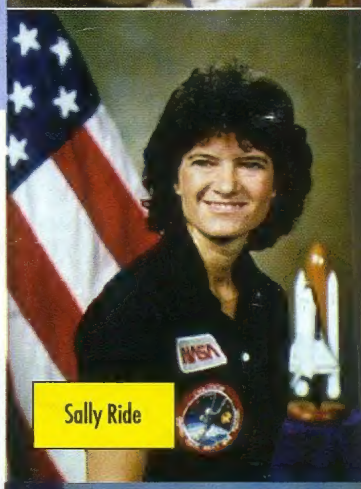
Many women have stayed in space for long durations in one single flight. Valentina Tereshkova stayed in space for 2 days and 22 minutes while the second woman Svetlana Svetskaya stayed for 7 days 21 hours. The longest single flight stay record is with Sunita Williams and the record is of 194 days 18 hours. The single flight space stay records have been given in Table 1.

The total flight duration (i.e. cumulative) records of women astronauts are more interesting. In this, Peggy Whitson tops with total flight duration of 376 days and 17 hours. Peggy Whitson also has also been the commander of the International Space Station (ISS) "ALPHA". At second and third number are Shanon Lucid and Elena Kondakova whose cumulative flight

Two women, Tracy and Janet Kavandi, have celebrated their birthdays in space. Five women have enjoyed New Year in space. These women are Catherine Coleman, Elena Kondakova, Sandra Magnus, Peggy Whitson and Sunita Williams.

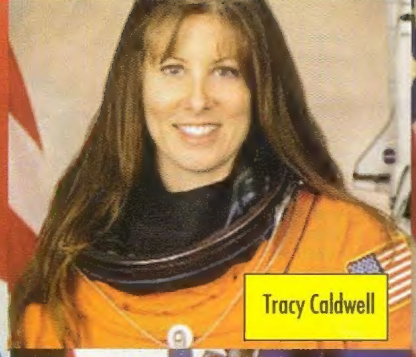

Valentina Tereshkova


Svetlana Svetskaya

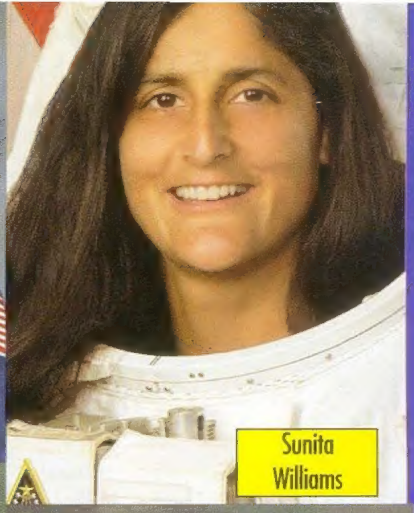

Sally Ride

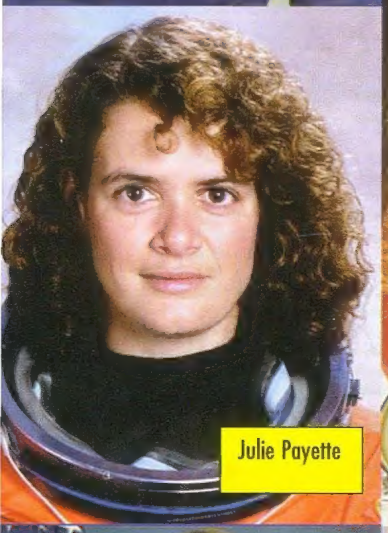

Naoko Yamazaki

Chiaki Mukai


Tracy Caldwell

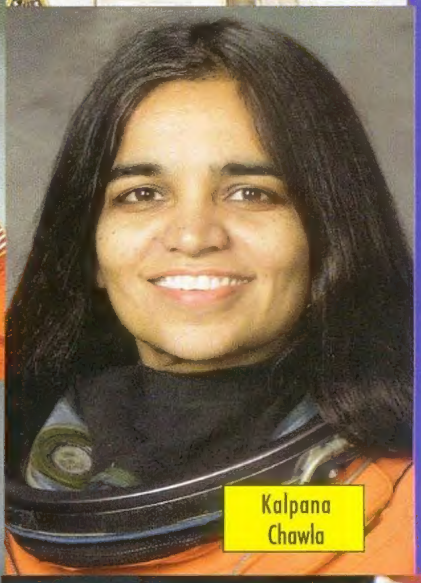
Dorothy Metcalf Lidenburger


Sunita Williams


Julie Payette


Sandra Magnus


Catherine Coleman


Kalpana Chawla

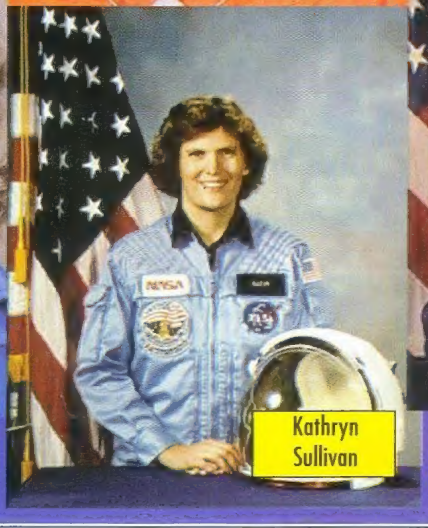

Pamela Melroy


Janet Kavandi


Stephanie Wilson


Roberta Bonder

Judith Resnik



Kathryn Sullivan

Shannon Lucid

In several instances over several space missions, women astronauts have been found to have an edge over their male counterparts both biologically and psychologically.

First six American women astronauts

durations have been 223 days and 2 hours and 169 days and 5 hours respectively.

Till date, the maximum numbers of flights for women have been five. The details are given in Table 2.

Space Walks by Women

Now, what is a space walk? Well, coming out of the spacecraft and performing assembly, repair and deployment is generally referred to as space walk or EVA (Extra Vehicular Activity). It is an extremely important part of human space flight for assembling space stations and servicing of various space telescopes like Hubble Space Telescope (HST).

Initial problems in the Sky Lab mission, the assembly of MIR and the International Space Station (ISS) could only be done through space walks. The space environment is hostile and dangerous for human beings. For coming out in free space one has to wear special space suits and lots of safety precautions have to be exercised.

Till date, 11 women have performed space walks. The first woman to do a space walk was Svetlana Svetskaya from the Soviet Union. The first American woman to do a space walk was Kathryn Sullivan.

In the environment of space, a woman, because of her nature, can adapt to various factors such as heat, spacecraft tremors etc better compared to a man.

Peggy Whitson is considered to be a great space walker amongst women astronauts. She has done six space walks of a total duration of 39 hours and 44 minutes. The details of space walks performed by women are given in Table 3.

In November 1984, Dr. Anna Fisher became the first person to retrieve a malfunctioning satellite with the remote manipulator arm. This became the first "salvage" mission. Dr. Rhea Seddon became the first to try a satellite repair out of the earth's atmosphere with the remote manipulator arm. She designed a makeshift "fly swatter" contraption space

Table 1.

FEMALE ASTRONAUT SINGLE FLIGHT DURATION (IN INCREASING ORDER)

S. No	Name	Achievement Days: Hours	Date and Time of previous achievements over running	Date and Time of previous records over running
1.	Valentina Tereshkova	2D : 22H	16. 6.1963	16. 6.1963
2.	Svetlana Svetskaya	7D : 21H	22. 8. 1982	22. 8. 1982
3.	Svetlana Svetskaya	11D : 19H	25. 7. 1984	26. 7. 1984
4.	Bonie DunbarEllen Baker	13D : 19H	07. 07.1992	08. 07.1992
5.	Margaret SeddonShannon Lucid	14D : 00H	10 .11. 1993	
6.	Chiaki Mukai	14D : 17H	22. 07. 1994	
7.	Elena Kondakova	169D : 5H	18. 10 .1994	19. 10 .1994
8.	Shannon Lucid	188D : 4H	07 . 09 . 1996	24 . 09 . 1996
9.	Sunita Wil	194D : 18H	16 . 06 .2007	

liams

Table 2.

INCREASE IN NUMBER OF FEMALE ASTRONAUT FLIGHTS

S.No.	Name	Number of Flights	Date of Launch
1.	Valentina Tereshkova	1	16.6.196
2.	Svetlana Svetskaya	2	17.7.1984
3.	Shannon Lucid	3	02.08.1991
4.	Shannon Lucid	4	18.10.1993
5.	Shannon Lucid	5	22.03.1996

Table 3.

WOMEN SPACE WALK OR EVA (EXTRA VEHICULAR ACTIVITY)

S.No	Name	New Achievement	Number of EVA	Date
1.	Svetlana Svetskaya	3h : 34m	1	25. 07.1984
2.	Katherine Thomton	7h : 45m	1	14. 05. 1992
3.	Katherine Thomton	14h : 21m	2	06. 12. 1993
4.	Katherine Thomton	21h : 11m	3	08. 12. 1993
5.	Sunita Williams	22h : 37m	3	04. 02. 2007
6.	Sunita Will	29h : 17m	4	08. 02. 2007
7.	Peggy Whitson	32h : 34m	5	18. 12. 2007
8.	Peggy Whitson	39h : 44m	6	30 . 01 . 2008

iams

Table 4.

TOTAL DURATION OF FLIGHTS BY WOMEN FROM DIFFERENT COUNTRIES

Order number	Country	Man-flights	Total durationof all flights	Percent ofthe worldduration
1	Canada	3	33d.13h.17m.	1.12
2	France	2	25d.14h.25m.	0.85
3	Japan	3	38d.18h.30m.	1.29
4	Korea	1	10d.21h.14m.	0.36
5	Russia/USSR	5	201d.02h.40m.	6.69
6	USA	114	2687d.13h.44m.	89.43
7	United Kingdom	1	7d.21h.14m.	0.26
Total		129	3005d.08h.60m.	100.00 :

It has been shown that biologically a female can do better in space exploration.

walkers attach to their arm. Rhea used the arm to grab a lever on the malfunctioning craft.

In April 1985, Dr. Kathryn Sullivan proved that it is possible to refuel a satellite during a spacewalk. In November 1985, Dr. Bonnie Dunbar, running a group of four missions, and logging 1,000 hours, worked with the crew of STS-61A to conduct the first comprehensive series of materials-processing experiments in space. And in May 1989, Dr. Mary Cleave became the first person to deploy a planetary probe from the Shuttle.

Some Interesting Records

Women astronauts hold some other interesting records too. Among the 20 oldest astronauts (on launch day among both males and females), Barbara Morgan comes at the 16th place while John Glenn (male astronaut) comes at the first place. Among the 20 youngest astronauts, Valentina Tereshkova is the second, Helen Sharman the fifth, Yi Soyeon the 12th and Sally Ride the 20th.

Two women, Tracy Caldwell and Janet Kavandi, have celebrated their birthdays in space. Calwell celebrated her birthday two times while Kavandi celebrated her birthday once. Five women have enjoyed New Year (each one time) in space. These women are Catherine Coleman, Elena Kondakova, Sandra Magnus, Peggy Whitson and Sunita Williams.

Till January 2011, women from seven different countries had gone into space and these women have passed a total of 2957 days and 6 hours in space, collectively. These details are given in Table 4.

Space was one male bastion that seemed to be impossible for women to conquer. But today, in several instances over several space missions, women astronauts have been found to have an edge over their male counterparts both biologically and psychologically. These women have helped future generations to realise that these occupations could be successfully held by women.

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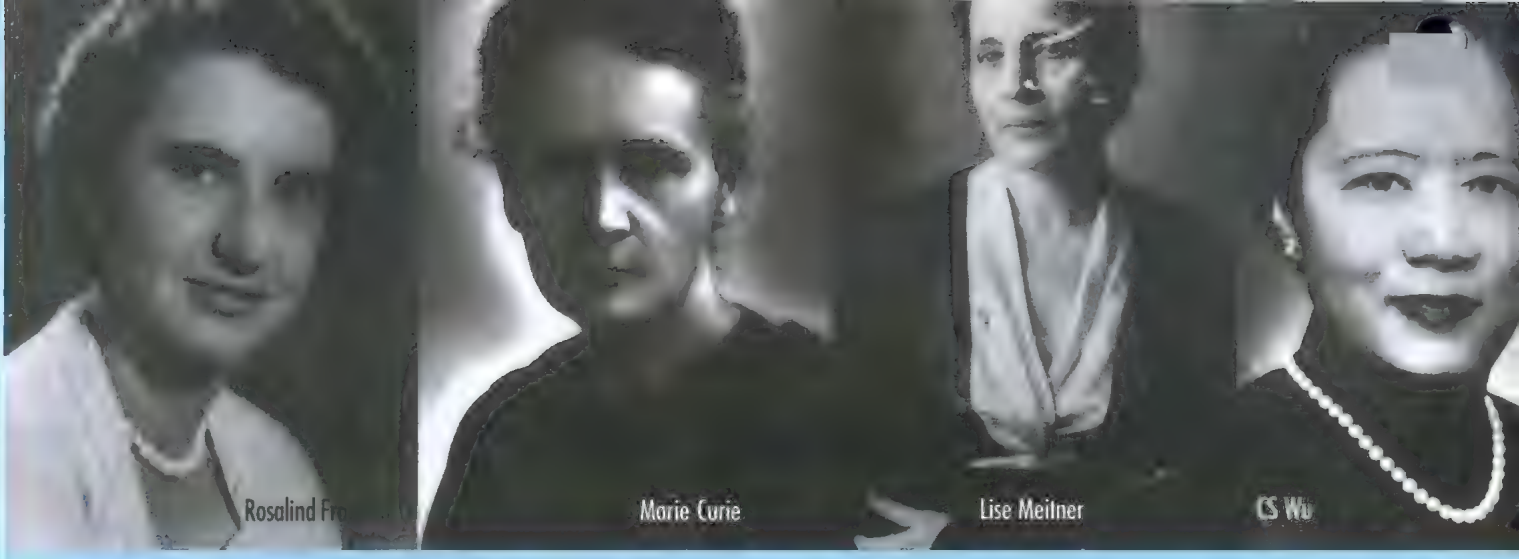


Female Stars in the Galaxy of Science

S.G. SEETHARAM

"Whatever women do they must do twice as well as men to be thought half as good. Luckily, this is not difficult." - Charlotte Whitton

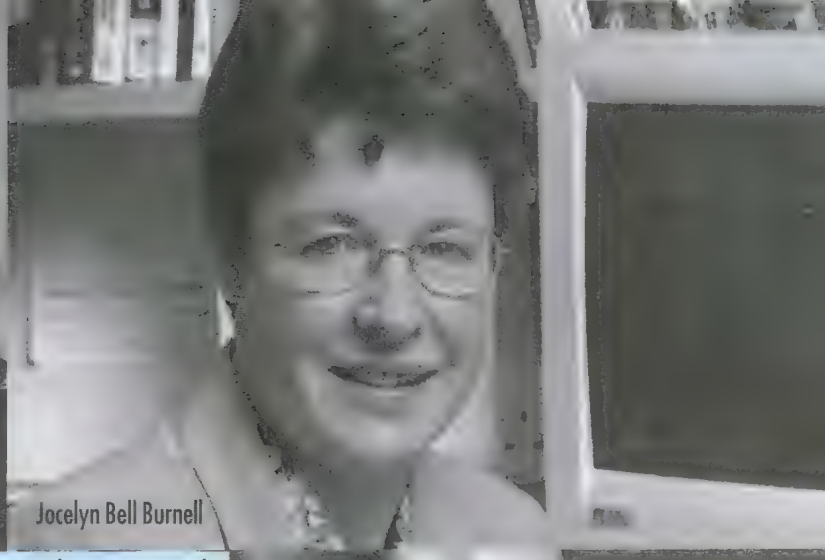
As a double-winner of the Nobel Prize, Marie Curie brought global prestige to the Nobel institution in the early part of the Twentieth Century. But, few names of women scientists have been noticed, leave alone celebrated, in the annals of Nobel Prize history ever since. For instance, how many have heard of Dorothy Hodgkin, who won the Chemistry Nobel in 1964 for determining the structures of important biochemical substances using X-ray techniques, and was a key figure in the famous Pugwash Conferences on Science and World Affairs? And, how many have cared to know who Maria Goeppert-Mayer was? (She was a co-laureate of the Physics Nobel in 1963 for findings related to nuclear shell structure, and remains *the only woman*, after Marie Curie, to have won the Nobel Prize in this category.)

Similar fundamental, anxious questions could be raised about Gerty Cori, the first Nobel Prize winning woman of America and the first female medical scientist to be inducted into the Nobel hall of fame (for identifying the course of catalytic conversion of glycogen), as well as Rita Levi-Montalcini, the Italian neurologist who co-won the Nobel Prize for Medicine in 1986 (for discovery of the Nerve Growth Factor) and is *the oldest living, longest-lived Nobel laureate* today. (She completed 102 years in April 2011.)

However, the real question here is not about women Nobel scientists being non-celebrities, but about the deeper issue of gender-discrimination in the matter of professional recognition, including the award of top international prizes. Indeed, all through history, virtually all the leading women of science, whether they received or missed the Nobel Prize, have suffered discouragement and rejection, harassment and humiliation, and torture and persecution in varying degrees at the hands of the ruling male scientists, solely because they happened to be women. It is little wonder then that *only 16 women* have so far appeared in the catalogue of science Nobel laureates since the Institution of the Nobel Science Prize in 1901.

Particular mention must be made here of four all-time great scientists who, as widely alleged in the science community, were denied their share of the Nobel glory on the mere grounds of their gender. One of the most publicized stories on this subject involves Rosalind Franklin (1920 –1958), the English molecular biophysicist and X-ray crystallographer, who was known as "The Dark Lady of DNA," and who made pioneering contributions to the understanding of the molecular structures of DNA, RNA, viruses, coal and graphite.

The case of Lise Meitner (1878 –1968), the Austrian-born Swedish physicist, whom Einstein called "Our own Marie Curie" and who co-discovered nuclear fission with Otto Hahn, is no less widely cited as a 'flagrant omission' in Nobel controversy literature. The two other scientists who richly deserved but never received the Nobel Prize were: Chien-Shiung Wu (1912 –1997), the Chinese-American physicist who was hailed "The First Lady of Modern Physics" and "Chinese Marie Curie," and who worked on the fabled Manhattan Project, and altered our very perception of the structure of the universe; and Jocelyn Bell Burnell (1943-), the British radio astrophysicist who was associated with her thesis-supervisor Antony Hewish in the Nobel-Prize-winning co-discovery of pulsars (rotating neutron stars).



There is no doubt that the female stars in the galaxy of science carry enough gravitational pull to effect the "Paradigm Reshift" from high-technology to high-science.

When the prestigious *New Scientist* magazine voted Marie Curie "The most inspirational woman scientist of all time" in July 2009 (Marie Curie, in fact, deserved to be proclaimed "The most inspirational scientist," *without* the gender adjective), several of the above names were in the top-10 list, along with Mathematician Hypatia of Alexandria; Ada King (English mathematician familiar to computer scientists as *history's first computer programmer*, and a key worker on Babbage's Analytical Engine); Marie-Sophie Germain (French mathematician of "Elasticity Theory" fame); Rachel Carson (American marine biologist who wrote *Silent Spring* that led to an extensive ban on DDT and certain other pesticides); and the legendary primatologist-ethologist Jane Goodall.

Some other historical figures that spring to one's mind in this context are: Emmy Noether (1882-1935), one of the greatest female mathematicians, who made signal contributions to the development of relativity theory as well as abstract algebra; Frieda Robscheit-Robbins (1893-1973), an illustrious pathologist who collaborated with George Whipple on his Nobel-Prize-winning endeavour for curing pernicious anaemia; Ellen Gleditsch (1879-1968), one of Marie Curie's distinguished research associates, who became a leader in chemical radioactivity and an ardent champion of the cause of women in academia and science; and Kathleen Lonsdale (1903-71), a Davy-Medal-winning crystallographer, who achieved a number of firsts for a female scientist, including 'first lady Fellow of the Royal Society' and 'first female president of the British Association for the Advancement of Science.'

Some other historical figures t in this context are: Emmy Noether (1882-1935), one of the greatest female mathematicians and Frieda Robscheit-Robbins (1893-1973), an illustrious pathologist .

It certainly strains our credulity to accept that gender-bias of a severe degree was prevalent in advanced countries as well, and that even world-renowned scientists were terribly sexist, but the fact remains that almost until recently girls were actively discouraged from pursuing science education even at the primary school level in all parts of the world, leave alone anti-feminine prejudice at the Nobel Prize level.

Thankfully, we have come a long way from all that sordid history, and women have now emerged as a force to reckon with, across the sphere of science. Women are actually making waves at the very cutting edge of science today, as powerfully instanced by the Nobel conquests of three outstanding scientists in 2009: Ada Yonath from Israel (Chemistry Prize for investigation into the structure and function of the ribosome, shared with Thomas Steitz and Indian-born Venkatraman Ramakrishnan); and Elizabeth Blackburn and Carolyn Greider, both from the U.S. (Physiology or Medicine Prize for research related to chromosomal protection by telomeres and telomerase, shared with Jack Szostak).

It is important to mentioned of four all-time great scientists were denied their share of the Nobel glory on the mere grounds of their gender.

It makes great sense to draw inspiration from the lives of yesterday's female giants of science, who rose above formidable roadblocks and made groundbreaking contributions to knowledge and society by virtue of their genius, vision and cultivated abilities. There is no doubt that the female stars in the galaxy of science carry enough gravitational pull to effect the "Paradigm Reshift" from high-technology to high-science that is urgently needed in education and research today.

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National Consultation on Women's Movement & Technology

(Organised by Feminist Approach to Technology, New Delhi; 14-15 October 2011)

A feminist approach to technology is an outlook that questions the existing structures of technology and seeks to incorporate women as equal partners within it. Equal participation of women in all aspects of technology (including decision-making) is desirable to ensure that development and growth of the field is better balanced, to promote gender equality and women's rights, as well as to see to it that any kind of technology does not affect women adversely.

Even though worldwide, the presence of women in the workforce has visibly increased, the numbers do not translate into higher membership in professions relating to science and technology (S&T). This is a cause for concern in development circles as well as in technology-based industries. Feminist Approach to Technology (FAT) that has been working in this field for the past few years organised a National Consultation with women's groups to discuss the relevance of S&T in women's rights struggles and to discuss how this understanding could be incorporated within organisational strategies.

Over two days, about 40 participants from more than 25 women's groups and organisations from around the country listened to activists and researchers, shared their own experiences and discussed challenges and ideas that they could work on collectively, in order to change the current skewed picture of women and girls in S&T in the country.

THEME I: Conceptual clarity on women and S&T

Chayanika Shah, Forum Against Oppression of Women (FAOW) & Lesbians and Bisexuals in Action (LABIA), Mumbai: *"Feminist Interrogations of Science and Technology"*

Chayanika posited that while on the one hand, technology helps fight against the status quo; on the other hand, it reinforces the very same marginalisations. Feminists look at increasing women's access to science, technology, engineering & mathematics (STEM) and actually critiquing the processes of science by bringing the lens of gender and patriarchy to scientific knowledge and scientific enterprises.

Chayanika introduced the Empiricist Approach that says that by including women, people from other marginalised sections, we can do good science. The claim is that this will lead to removal of biases in the practice of science and will make science better. Chayanika believes that the work that is happening today is more centred on scientists actually saying that they are feminists and, as such, are trying to "do (their) science differently". That's what brings in new kinds of work, and that is why science has changed.

Chayanika concluded by saying that in the process of trying to get more women into science, we as feminists, should change the nature of science education, give science a feminist critique, engage with it and look forward to retaining a different kind of science.

THEME II - Panel discussion: Current situation of women and girls

1. **Deanna Kosaraju, Anita Borg Institute for Women & Technology, USA & Grace Hopper Celebration of Women in Computing, India:** *"Women in tech today"*

Deanna talked about the research that her organisation was doing to understand the challenges of retention of technical women in North America. They have also been talking to women in India about some of their challenges and found similarities and differences. In the US, the pipeline for technical women is very small and the dropout rate very high, mostly because of family challenges, but also because of the "very masculinised" nature of technology. These issues are similar for women in India. Deanna discussed about increasing their employability through mentoring programmes, and training in soft skills.

2. **Dr. Maitreyi Chandra, NCERT (Retired):** *"Girls in science education"*

Dr. Chandra outlined the reasons for the poor status of girls in S&T: social consequences (a lack of encouragement from family and others around them); the shop-floor training that they (do not) receive; brain drain (mainly to the US, true for girls and boys both); the inherent biases in the system (for e.g., mostly boys are recruited during campus interviews); the glass ceiling as one climbs up in the hierarchy; even the education system that portrays women in a certain way. She ended her talk by speaking about the importance of men participating in platforms like this, so they too, understand the issues that women and girls face in science.

3. **Sreelekha Nair, Centre for Women's Development Studies, New Delhi:** *"Women and technical knowhow: A difficult relation?"*

Sreelekha talked about the formal workplace of women engineers at the Kerala State Electricity Board (KSEB), where they join at a certain level and move up the ladder. However, the informal policies at play make the workplace a difficult arena for the professional women who are employed there. The engineers (men and women) learn technical skills, but not the social skills that would make the workplace more gender-sensitive. Thus often, women stay low down in the hierarchy, even if they have the skills and knowledge to move upwards, and this is what makes the workplace a difficult place for the women engineers.

THEME III: Women's movement and S&T

Vani Subramanian, Saheli, New Delhi: *"Making sense of technology: Re-visiting some feminist journeys"*

Vani's talk centred around certain kinds of knowledge systems and joint campaigns that the women's movement (and Saheli in particular) have engaged with over the years through its advocacy and campaigning. The health campaigns gave feminist activists the courage to question the authority of knowledge and to try and make sense of specialised technical information.

She traced health activism from early campaigns against estrogen-progesterone (EP) drugs and the unethical trials on women from marginalised communities in Andhra Pradesh, to injectable contraceptives and implants. In order to demand government accountability, activists had to understand composition, short- and long-term impact on women's bodies and major and minor side effects. These campaigns set the template for how activists fought health campaigns: *at a social level,* the implications on women's health; *at a technical level,* understanding what the drug was doing, and, *at an intellectual level,* demystification of the information.

In order to understand the texture of the campaigns, Vani played two clips from an iconic film made by Deepa Dhanraj in 1991, *"Something like a war"*. It showed how women's bodies were abused in the name of family planning through the use of

different kinds of invasive hormonal contraceptives. Informed consent of the women was not taken.

THEME III: Panel Discussion

1. **Anja Kovacs, Internet Democracy Project:** *"Internet and freedom of expression"*

Anja discussed Internet governance and why it was time for feminists to be concerned about it and to intervene in the formulation of rules and policies at both national and international levels. With examples, she showed how they affect not just our daily lives, but also our freedoms and the social issues we work with. The historically open nature of the Internet is slowly changing. Increasingly, big capitalist corporations are controlling it, such that its structure and the potential for empowerment is decreasing while surveillance is increasing. Anja emphasised the importance of feminists' involvement in advocacy around the Internet.

2. **Sonali Khan, Breakthrough, New Delhi:** *"The* Bell bajao *campaign and the effective use of media"*

Sonali presented Breakthrough's relationship with technology in the work that they do. The *Bell bajao* campaign is one aspect of it. Apart from that, she touched upon SMS campaigns that are helping raise awareness about issues related to domestic violence and women's rights. Breakthrough is also using mobile technology to mobilise young people in rural parts of the country and bring about change in gender relations.

3. **Sharmila Bhagat, Ankur, New Delhi:** *"Young women & technology"*

Sharmila talked about Ankur's work with young women and men through their Cyber Mohalla Media Labs. The place has become a dynamic space for young people to debate, discuss and create campaigns; they feel empowered that they "own" this space. They share experiences and messages through a variety of media like postcards, stickers, books, wall magazines, booklets and blogs.

4. **Preeti Nayak, Sama, New Delhi:** *"Debates & dilemmas of assisted reproductive technologies"*

Preeti shared Sama's thoughts, reflections and work related to Assisted Reproductive Technologies (ARTs). These are a group of technologies that assist in conception and pregnancy, encompassing various procedures including intrauterine insemination (IUI) and In Vitro Fertilisation (IVF). Surrogacy is also included under the umbrella term of ARTs. Apart from currently being invasive, expensive and unregulated, ARTs pose significant risks to women's reproductive health.

THEME IV: Technology and capitalism

Kalpana Mehta, Saheli, New Delhi: *"Women and Technology: For whose benefit, at whose cost?"*

Kalpana said that market is not just what one needs, but is an entire process of *creating needs*. One does not think of sustainability, but instead, of *how to make things obsolete faster*. So on the one hand, we fall into the "worker" trap, and on the other, into the "consumer" trap. In India, the largest spender in S&T is the government. However, 82% is for defence or the armament business and only about 18% is for agriculture and industry. At one level, one is standing on a technological threshold with the possibility of a good and prosperous (not in the material sense) society. It is the political and economic system that hinders this and this is what we need to focus on.

Creating politically and socially neutral women scientists would be self-defeating. They should differentiate themselves from others through political education, awareness about environmental damage, social responsibility, valuing of life and sustainability. This is a way to strategise and plan for the future.

THEME V: Understanding science with a feminist lens

Dr. Vineeta Bal, National Institute of Immunology & Saheli, New Delhi: *"Feminists and technology: Another perspective is possible!"*

Vineeta presented her "somewhat different take" on S&T as a feminist, scientist and a health activist. As feminist and health activists and environmentalists, we do not have any direct control on the development of technologies. We look at all technological development judiciously and function as a pressure group, trying to regulate undesirable spread of technologies and putting regulatory conditions for their use. Vineeta described five categories of technologies, based on their actual and potential impact on human lives (specifically women's lives):

- Technologies with implicit anti-woman formulation in conception, development and use (for example, asexual reproduction)
- Not the original purpose but practice becomes anti-woman (for example, reproductive cloning & emergency contraceptives)
- Secondary outcomes of technology, even if unintended, turn out anti-woman (mobile phones with camera & the Internet)
- Very large scale use turns out anti-woman (ultrasonography & genetically modified crops)
- Dominantly acceptable, minimally objectionable technologies (male and female condoms, iodised salt)

[The mission of Feminist Approach to Technology (FAT) is to empower women by enhancing women's awareness, interest and participation in technology; Website: www.fat-net.org]

"A Woman is Always Expected to be a Good Homemaker..."

PROF. GEETHA BALI, Vice Chancellor, Karnataka State Women's University, Bijapur has also been elected as the General President of the 99th Indian Science Congress being held at KIIT University, Bhubaneswar. She is only the fourth woman to have been elected thus.

Prof. Bali graduated from the Bangalore University and obtained Ph.D. in the field of Neurophysiology. Prior to her appointment as the Vice Chancellor, she was serving as Professor, Department of Biotechnology, Coordinator, Center for Clean Environment Technology which was founded by her and Coordinator, Bioinformatics facility at Bangalore University.

She was awarded the Young Scientists' career award by the UGC, IFAS scholar by the University of Florida, Gainesville, USA and Star News B School award 2011. She is a Fellow of the Alexander von Humboldt Foundation, Germany and continues to collaborate with institutions in Germany. She was appointed as a Fellow of Salzburg Seminar, Austria. She is also a Fellow of the National Academy of Sciences, India.

As Vice Chancellor of the Karnataka State Women's university, Prof. Geetha Bali has implemented a number of innovative programmes including the establishment of "Koushalya Women's Technology Park", the only one of its kind in any Indian University, with a variety of facilities serving as skill training, awareness creation and research centres as well as business incubators enabling women to benefit from science and technology.

***PROF. GEETHA BALI,** in an E-mail interview with **Hasan Jawaid Khan,** talks of issues and attitudes that have put road-blocks in the way of more and more women succeeding in the arena of science.*

HASAN JAWAID KHAN: The issue of fewer women in science has always been a matter of concern. What do you think are the reasons for this being the case? Are there certain societal barriers that limit the advancement of women in science?

GEETHA BALI: There are multiple causes. There is certainly societal barrier against women pursuing science. The general feeling even amongst the educated is that arts and social sciences are more suitable for women. She is always expected to be primarily a good homemaker and all her other roles take secondary importance in the minds of people.

Science courses are generally more expensive. When it comes to spending money on education, parents are hesitant to invest more for a daughter's education.

Besides, in rural areas, there is a language barrier. They are encouraged to pursue primary education in regional language and also education in regional language is subsidized or free. Not giving sufficient importance to teaching of basic English during primary education has resulted in creating diffidence in learning English and pursuing science. Learning science in regional language can be more challenging since they are more familiar with English terms. All this has compounded the problem.

HASAN JAWAID KHAN: Do biological constraints also in some way influence the representation of women in science?

GEETHA BALI: I don't think so.

HASAN JAWAID KHAN: What would you say to people who persist in believing that women's abilities, talents or interests are more suited for the helping professions, such as teaching, than for the sciences?

GEETHA BALI: This attitude will only result in not utilizing the talents of nearly 50% of the population. Many women scientists who got opportunity to become scientists have done extraordinarily well. The most quoted example is that of Marie Curie who has created an unsurpassable record while working against all odds. Similarly, men have done outstandingly well as writers, teachers, dancers, singers, painters, and chefs. In fact, the world's highest paid chef is an

"About 99.9% of the parents believe education and profession are primary goals for sons and family care is the primary goal for daughters."

"Compelling a woman to study arts because she is a woman and compelling a man to study engineering because he is a man are both equally bad."

Indian man. Going by these examples, should men be encouraged to learn arts and culinary skills only?

Decades of research to prove differences in the functioning of the brain of women and men has been inconclusive. The capabilities of the human brain are the same irrespective of the gender. Compelling a woman to study arts because she is a woman and compelling a man to study engineering because he is a man are both equally bad. I strongly believe that this "belief" that women do better in teaching and non-science subjects is an excuse for relegating her to courses or professions that are of lesser priority for men. If we want our children to excel and become outstanding personalities, which every parent wants, they must be allowed to pursue what they like most, enjoy learning most and not subject them to skewed thinking about subjects and professions.

"Many women scientists who got opportunity to become scientists have done extraordinarily well. The most quoted example is that of Marie Curie who has created an unsurpassable record while working against all odds."

HJK: Do parents of today still have different educational expectations and goals for sons and daughters?
GEETHA BALI: Certainly yes. About 99.9% of the parents believe education and profession are primary goals for sons and family care is the primary goal for daughters.

HJK: Are their certain fields that are more preferred by females?
GEETHA BALI: I don't think so. Environment often robs them of their originality and puts in set ideas the society is more comfortable with.

HJK: What would you say are some qualities that especially endow women with the capabilities required in the pursuit of science?
GEETHA BALI: Versatility, multitasking abilities, endurance and perseverance, which are so much required for scientific research, meticulousness and ability to be highly organized.

"Positive discrimination is absolutely essential to bring in any change. Soft-pedaling the issue half-heartedly is not going to yield any results."

"Spare no efforts to improve the quality of your research. Lot of reading and learning new techniques is most important. Make all efforts to present your work in scientific fora and interact with other scientists. Doing science in isolation and confining to lab and the guide are not healthy and will further contribute to your being marginalized."

HJK: What can be done to increase the representation of women in science and to provide them an equal opportunity in science?
GEETHA BALI: Increase enrolment of girls in science courses in high school through motivation and incentives. Focus on quality of science teaching in girls-only schools. Fee for science courses are always higher and parents opt for cheaper courses for girls. Fee structure should be the same irrespective of the course, at least for women.

HJK: Can the education system do more to encourage young girls to opt for scientific careers than is currently the case?
GEETHA BALI: Yes. Many things can be done. Nothing at all has been done so far for promoting science education for girls in primary and secondary schools.

HJK: Can positive discrimination be considered to promote women scientists as it will help tackle skills shortages in scientific disciplines in the years to come?
GEETHA BALI: Positive discrimination is absolutely essential to bring in any change. Soft-pedaling the issue half-heartedly is not going to yield any results.

HJK: What would your advice be to a young female scientist?
GEETHA BALI: Spare no efforts to improve the quality of your research. Lot of reading and learning new techniques is most important. Make all efforts to present your work in scientific fora and interact with other scientists. Doing science in isolation and confining to lab and the guide are not healthy and will further contribute to your being marginalized.

❐

Women have an edge when it comes to communication in speech as well as in actions. Therefore, women could also be great science communicators and this quality needs to be harnessed.

PARUL R. SHETH

Women as Science Communicators

SINCE times immemorial women have been known to possess good communication skills. Their ability to listen, to talk, to empathise and to deal with emotions – are all qualities of an able communicator. This ability to communicate can be used to a better advantage especially in the fields of science and science communication.

When we talk about science communication, it includes introduction of science as a part of everyday life and making it accessible to people, thus bridging the gap between science and society. Scientific awareness among people, amongst other things, helps demystify myths and in tackling superstitions that are often used to fool people and to extract money or loyalty out of them. Science communication also helps promote science for development and creates awareness in the minds of the masses.

Today, science and technology is progressing at a very fast pace. The developments taking place are affecting the lives of people both in the short and long terms. So, it has become imperative that this scientific knowhow be better understood and harnessed, with enhanced levels of scientific awareness. Also, it can become easier to contend and feel comfortable with the lifestyle and societal changes that use of new technology brings in its wake with a better understanding of science.

The advantage women have over their male counterparts is the presence of a channel of communication with the baby even before it is born.

It is true that some scientists are better communicators, especially those who share their fascination about their work with the wider community. However, there are many others who stare at a good story in the face every day and yet are unable to recognise it. This is when a science communicator comes in to play; he/she takes an intriguing story, obliterates the scientific jargon, and presents it to the masses.

Communicating science is no trivial task but women can play a crucial role in here. The advantage women have over their male counterparts is the presence of a channel of communication with the baby even before it is born.

Garbha Sanskara

In India, we say that the baby can hear you from the womb and thus can be educated even before it is born. Sending positive vibrations and energy to the baby is a scientifically proven technique, which we call as *Garbha Sanskara*. *Garbha* in Sanskrit means foetus and *Sanskar* means educating or informing the mind.

The technique involves acoustic stimulation in the form of chantings, music and talking to your baby in the womb. This enhances the brain function of the baby thus initiating the parent-child bonding right from the time the baby is in your womb. Most importantly, it is the mother who is communicating with the baby in the womb even before it is born thus transcending all language barriers of communication.

Women are Genetically Tuned to Communicate

Girls arrive wired as girls and there are inherent differences between the male and female brains, which explain why women are naturally more communicative in speech as well as in actions than men. And therefore women perceive the world differently from men. Women have an eight-lane superhighway for processing emotion, while men have a small country road.

More specifically, the brain circuitry and hormones that make women so much more attuned make them better communicators than men. Research studies reveal that a woman can process about 20,000 words in a day as compared to 7,000 a day for men. Interestingly, women are good at gestures that again make them communicate well.

Being a Mother Gives her an Edge

Good communication needs a basic understanding and appreciation of values, perceptions and needs of those we are communicating with. Science communication deals with the task of making science a part of everyday life, accessible and exciting to youngsters and lay people.

As a mother, a woman feeds her baby, tends to its needs and inculcates good habits. Children have the ability to pick from the actions they see and tend to imitate the same. The learning process for the child begins from here. This is the best time to encourage scientific literacy in children where science is as vital as reading or writing. The knowledge in practical science in the kitchen, working of gadgets, and science at the dining table, hygiene and sanitation – all begin at a tender age.

Women are Better Teachers

Women have an advantage of being good teachers because they are the ones who spend more time with children. Hands-on learning experience makes learning a ,oy for school going children. Teachers basically are trained to become good communicators and good communicators make good teachers.

Creating engaging exhibits to explain complex science concepts is a challenge that faces teachers. Perhaps science teachers arguably do more science communication than others. The curriculum in the text is important yet there is science all around you, which needs your attention.

Women Science Communicators in India

India is a multilingual country and we have 18 Indian languages with varied dialects. Overall, the literacy rate for women is 39 per cent against 64 per cent for men.

We have several science communication organizations across India. These include the National Council for Science & Technology Communication (NCSTC), Council of Scientific & Industrial Research (CSIR), Marathi Vigyan Parishad (MVP), Kerala Sastra Sahitya Parishath (KSSP), Vigyan Prasar, Indian Science Writers Association (ISWA), National Centre for Science Communicators (NCSC), Homi Bhabha Centre for Science Education (HBCSE),

Marie Curie, the woman scientist once said, "One never notices what has been done, one can only see what remains to be done."

and so on. However, participation of women in communicating science in Hindi, our national language, is merely 7-8 per cent. The Kerala Sastra Sahitya Parishath has a membership of about 45, 000 and women's share is around 11 per cent. Likewise the number of women science communicators in various organizations is dwindling.

We also have the Indian Women Scientist's Association (IWSA), a voluntary, non-political, secular organization registered in 1973, having 10 branches in India. The objective of IWSA is chiefly to develop scientific temper. It has a total membership of 2000 women, who have minimum science graduation or a diploma in basic and applied sciences and more.

Women Science Communicators in Rural India

The practical aspects of science learning processes do not end here. About two thirds of India's more than 1 billion people live in rural areas. Although many rural people are migrating to cities, three out of four of India's people live in the vast rural parts of the country. And the emphasis here is mainly on health issues including hygiene, nutrition, reproduction, agriculture, water issues and so on. Women related issues are where women science communicators in India have a lot to contribute.

We have barefoot doctors who are rural men and women trained by experts to become village-level health workers who then take care of the community health of villagers. Women health workers and science communicators are able to reach out to the women folk and teach them about the importance of health, hygiene, contraception, vaccinations, nutrition and so on.

There are several women science communicators who have taken up rural development as a challenge

The village men and women today are offered a comprehensive reproductive health care package. The women health workers even act as midwives, they are able to inject medicines, give first aid, etc. The villagers are taught to measure temperature in case of fever, take blood pressure, prepare oral rehydration solution (ORS) in case of diarhhoea, give knowhow and stress upon the importance of personal hygiene and sanitation and prepare a healthy environment all around.

There are several women science communicators who have taken up rural development as a challenge and are working towards it. One such example is that of the Arole doctor couple from Maharashtra who began their efforts of imparting science education in rural areas as early as in the 1970s. In 2008, Her Excellency, the President of India, Smt. Pratibha Patil conferred the National Award for Women's Development through Application of Science and Technology on Rani Bang on the occasion of International Women's Day.

Rani and her husband Abhay, both doctors originally from a district called Gadchiroli in Maharashtra, have empowered rural women to take care of their community's health. Today, infant mortality in that area has reduced by over 75 per cent. In 1986, Rani founded the voluntary organization Society for Education, Action and Research in Community Health in 1986.

Challenges Faced by Indian Women

In a report *A Global Perspective on Research and Development* by the UNESCO Institute for Statistics (UIS) in 2009, the gender gap in science was examined. It was found that women scientists make up only 29 per cent of researchers in 121 countries; they remain a significant minority in many developing countries especially in South Asia and Africa as per the report.

The crux of the problem here is that women at all stages continue to struggle for equality in patriarchal and both traditional and modern societies. They face challenges at every step. Women have a tough time having a smooth career even with study of science and technology because of the infamous 'glass ceiling'.

Women are under-represented in science and technology at various levels, the reason being barriers to entry and achievement at all stages of the academic ladder and also later in life. Even today the negative socio-cultural attitudes towards education of women exist.

While talking to *Sci Dev*, Prudence Mutowo, winner of the 2006 L'Oreal UNESCO Fellowship and a Ph.D. student in molecular biology at the University of Nottingham, UK says, "I wanted to go into science primarily because people said I couldn't. I came across people saying, women don't really go into science, why don't you study history or languages?"

According to a letter published in the *Journal of Science Communication*, SISSA – International School for Advanced Studies, Via Bonomea, Trieste, Italy by Drs. Daniele Gouthier, Federica Manzoli and Donato Ramani, when choosing a career, girls are much less likely to pursue scientific careers such as engineering or physics. The evidence is provided by the Gender Awareness Participation Process (GAPP) research project, which investigates differences between girls and boys in their perception of science careers.

The Indian Perspective

Overall, in India the literacy rate for women is 39 per cent against 64 per cent for men. About 35 per cent of science graduates are women. But it is true that many women come into graduate programmes in science with a low-degree of confidence. Also, pregnancy and childbearing still have negative consequences for women. Too many women leave science altogether due to constraints of family and motherhood.

As reported in a publication by the Indian National Science Academy, New Delhi on 'Science career for Indian women: An examination of Indian women's access to and retention in scientific careers', large-scale gender discrimination and inequity have denied Indian women opportunities for education and employment on par with men. In this study an attempt was made to obtain information about women employed in faculty and technical positions in various government institutions such as DST, DBT, CSIR, ICAR, ICMR, DAE, and DOD and three universities namely Indian Institute of Science (IISc), Bangalore, Hyderabad University, and Jawaharlal Nehru University (JNU), New Delhi.

The INSA study has revealed that DBT followed by ICMR are the best employers of women. Representation of women in the other organisations is less than 15 per cent both at scientific and at technical levels, proportion of women in national laboratories and prestigious universities is less than 15 per cent, except in DBT and ICMR where the percentage exceeds 25 per cent.

Coming Out of the Shell

One of the beautiful aspects of science communication, but also its main difficulty, is its multidisciplinary character. The strength of women science communicators is still in a dismal state. This may be true because being a communicator you have to come to terms with politicians and people in power, which is expected to be difficult for women in the field. For women to be able to survive in this man's world of domination is an uphill task.

Yet in the last decade, India has seen women excelling academically. The future looks sunny. Women in science are often abbreviated as WISE and indeed it is this wisdom and participation of women in science communication that will help bring science and society together in our daily lives. The inherent female qualities – the convincing power and perception – make it easy for women to convey science to people.

Science faces a major problem of losing attraction amongst the young people. Who can do it better than women? Marie Curie, the woman scientist once said, "One never notices what has been done, one can only see what remains to be done." So, based on our past we can build our future.

Former President of India, Dr. A.P.J. Abdul Kalam once said, *"When women are empowered, a society with stability is assured. Gone are the days when women were considered subservient or secondary in almost all walks of life compared to men. It has now amply been proved that women are capable of executing any job as efficiently as men, if not more so."*

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KNOW ABOUT THESE WOMEN SCIENTISTS?

SHOILI PAL

1. **How many women have got the Nobel Prize till date?**
   a) 24
   b) 34
   c) 44
   d) 54

2. **In what branch of science did Nobel Laureate Barbara McClintock work?**
   a) Astrophysics b) Genetics
   c) Inorganic Chemistry d) Neurology

3. **Caroline Herschel was the first woman to find which heavenly object?**
   a) A planet
   b) A satellite
   c) A galaxy
   d) A comet

4. **Who was the first woman in space?**
   a) Kathryn D. Sullivan
   b) Svetlana Savitskaya
   c) Sally Ride
   d) Valentina Tereshkova

5. **Who was the first civilian in space?**
   a) Judith Resnik
   b) Valentina Tereshkova
   c) Yuri Gagarin
   d) Neil Armstrong

6. **Who was the first woman to be granted a patent by the USPTA?**
   a) Ellen Ochoa
   b) Grace Hopper
   c) Mary Kies
   d) Sarah Boone

7. **Jane Goodall is the world's leading expert on which animal?**
   a) Crabs
   b) Chimpanzees
   c) Storks
   d) Ants

8. **Who is considered to be the world's first computer programmer?**
   a) George Stibitz
   b) Grace Hopper
   c) Charles Babbage
   d) Augusta Ada King

9. **Who developed the first compiler for a computer programming language, instrumental for developing COBOL?**
   a) Grace Hopper b) Charles Babbage
   c) Augusta Ada King d) George Stibitz

10. **Ada Yonath is known for her work on which of the following?**
    a) Ribosomes
    b) Telescopes
    c) Semiconductors
    d) Animal Conservation

11. **Which of the following children's authors was also an expert on fungi?**
    a) Beatrix Potter
    b) J.K. Rowling
    c) Holly Black
    d) Enid Blyton

12. Which of the following women was the first living scientist to have an asteroid named after her?

a) Caroline Herschel
b) Maria Goeppert Mayer
c) Marie Curie
d) Chien Shiung Wu

13. Who holds the record for most comets discovered by an individual?

a) Margaret Geller
b) Carolyn Shoemaker
c) Henrietta Leavitt
d) Caroline Herschel

14. Who discovered Radium and Polonium?

a) Rutherford
b) Mendeleev
c) Irene Joliot-Curie
d) Marie Curie

15. Whose book 'Silent Spring' is considered by many to have given birth to the modern environmentalist movement?

a) Rachel Carson
b) Anne LaBastille
c) Margaret Murie
d) Nancy Newhall

16. Watson and Crick are credited for discovering DNA. Who was the woman whose role is considered to be equally important?

a) Jean Hanson
b) Elizabeth Blackhall
c) Rosalind Franklin
d) Gerty Cori

17. Who was the first woman member of the American Academy of Arts and Sciences?

a) Nancy Cartwright
b) Maria Mitchell
c) Grace Hopper
d) Patricia Spear

18. Who invented the Windshield Wiper for cars?

a) Edith Flanigen
b) Ruth Handler
c) Mary Anderson
d) Josephine Cochrane

19. Who invented Kevlar, which is used to make bullet-proof vests?

a) Patricia E. Bath
b) Stephanie Kwolek
c) Josephine Cochrane
d) Mary Kies

20. Which of these phenomena did physicist Lise Meitner and her partner Otto Hahn discover?

a) Beta radiation
b) Gamma radiation
c) Nuclear fusion
d) Nuclear fission

21. Who is the oldest living Nobel Laureate?

a) Rita Levi-Montalcini
b) Elinor Ostrom
c) Doris Lessing
d) Carol W. Greider

Answers:

1. c	2. b	3. d	4. d	5. b	6. c	7. b	8. d
9. a	10. a	11. a	12. d	13. b	14. d	15. a	16. c
17. b	18. c	19. b	20. d	21. a			

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RAVINDRA VAZE

Lives of Scientists

CHARLES Fredrick Chandler earned his reputation as one of the first outstanding industrial chemists of the United States. Born in 1836, he worked under Wohler at Gottingen and Heinrich Rose at Berlin, getting his doctorate degree in 1856. Returning to the US he established the school of mines in Columbia, where he was a professor for 36 years and dean for 33 years. He earned large fees as a chemical expert, but gave away a large sum of it to the poor and needy students. Dr. Chandler's lectures were always filled with humor, witty stories and amusing anecdotes.

In one of his lectures on specific gravity he told the students that any substance lighter than water will not only float on it but will displace a volume of water equal to it's buoying capacity. To drive home this point into the minds of the students, he narrated an amusing story. A Baptist minister was embarrassed, as he could not immerse completely in water an elderly and voluminous sister of the church. The church physician witnessing the awkward situation of the Baptist, called him and said, "Dear friend, I am the physician of the lady in question. I think you better not attempt the heroic feat with her because she gets buoyed up by the gas in her stomach and has a wooden leg!"

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Chandler as a chemical expert had to attend lawsuits in connection with the technical disputes of industries. An overconfident and a rather obstinate lawyer was to cross-examine him.

The lawyer said, "Whenever I grill the so-called chemical experts, I always make it a rule to eat something before breakfast."

Retorted Chandler, "Dear lawyer, from your appearance it goes without saying that it is the reason why you have more brains in your stomach than in your head."

****

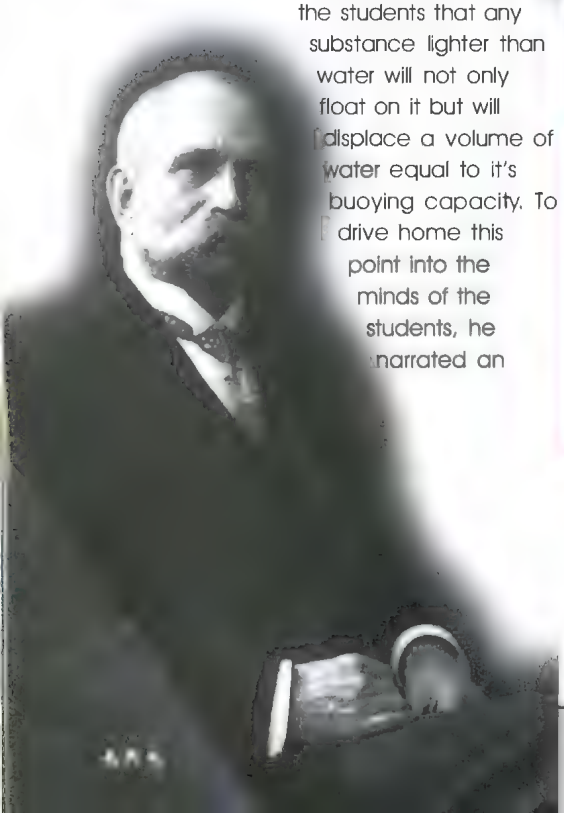
On another occasion Chandler was asked by the chairman of a company to address a meeting with telegraphic brevity. Chandler began with the following words, "The honorable chairman has asked me to address with telegraphic brevity. But as you all know the body of the telegram is usually ten words, the address is always unlimited...!"

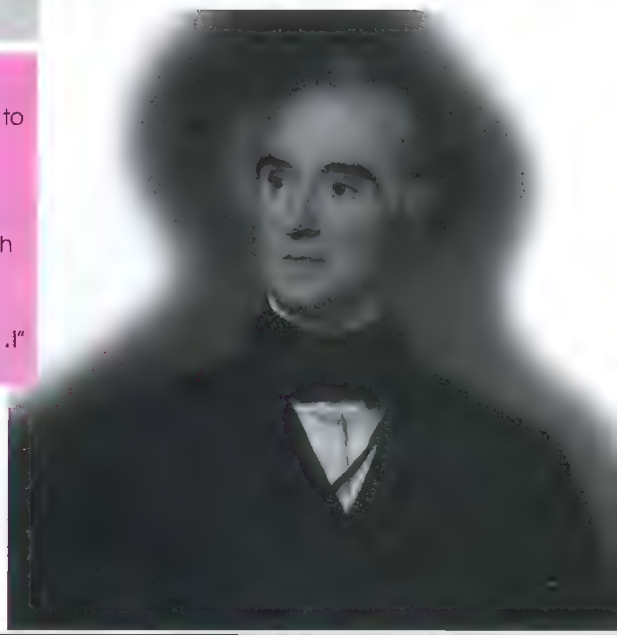
****

An American senator, who by profession was a lawyer, had the habit of putting his hands in his pockets while talking. In a public meeting, he jokingly introduced Chandler as a doctor who takes his own medicine. After a while, when it was the turn of Chandler to speak, he said, "The senator who introduced me is the eighth wonder of the world—a lawyer with his hands in his own pockets!!"

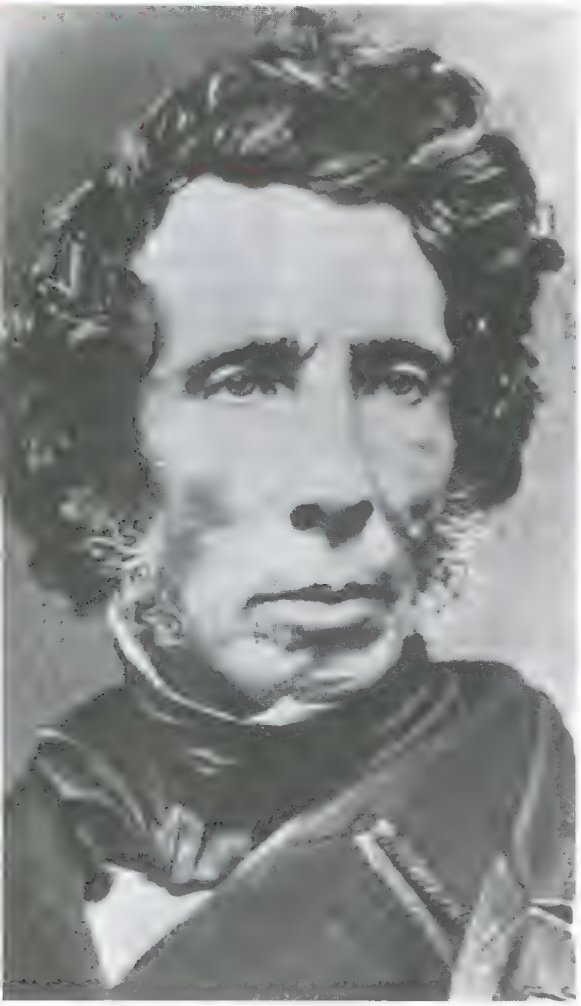
****

Justus Leibig and Fredrich Wohler, the two stalwarts of organic chemistry, were great friends, true to the meaning of the word. But this serves as an antithesis to the temperaments of these two great men of science. Leibig running over with enthusiasm, hot tempered, keen for conflict, always involved in long disputes. Wohler on the other hand was gentle, cautiously avoiding overstatement and yet artfully pacified the emotions of his friend. The following letter from Wohler exemplifies an effort to refrain Leibig





Charles Fredrick Chandler (left)
Justus Leibig (right)



Fredrich Wohler

from one of his attacks on Marchand, a contemporary chemist.

Wohler writes: "To make war against Marchand, or any one else is no use. It brings no contentment, merely affects your nerves and leads to swallowing of Morrison pills. Imagine yourself in the year 1900, when both of us will be decomposed again into carbonic acid, water and ammonia. The lime of our bones will be a feast to the dog who dishonors our grave. Who then will care to know how we lived? Who then will know of your sacrifices of health and peace for science? Only your work filtered off from all that is unessential will be carried into the next generation. But how do I come to counsel the lion to eat sugar!"

Nevertheless it proved to be a hopeless task, as Leibig although acknowledging Wohler's good sense continued to defend his convictions in all the controversies, till the very end of his life.

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Freidrich Wohler, the great organic chemist, while taking one of his usual rounds in the laboratory noticed a student leaning on his elbow and gazing intently at a solution on his table.

"What are you doing? asked Wohler.

"Oh, I am crystallizing," answered the student somewhat over enthusiastically.

"In that case, I would suggest you not to move an inch, else, the crystallization will stop!" was the humorous reply from Wohler.

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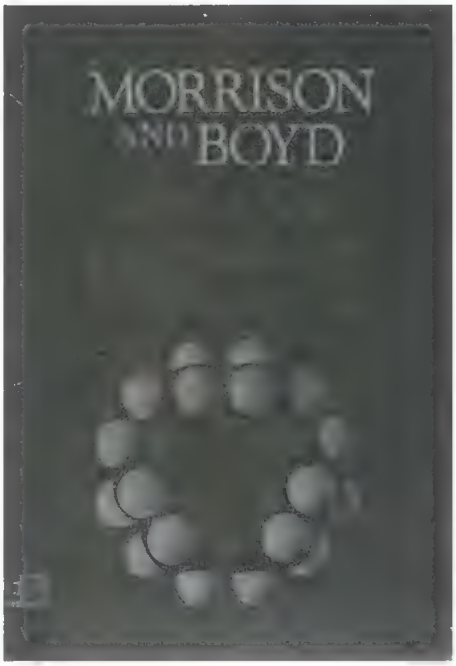
Antoine Laurent Lavoisier, one of the greatest chemical revolutionaries, ironically was one of the victims of the French revolution in the last decade of the eighteenth century. This was one of the most heinous acts in the history of mankind. In 1794, he was arrested by the revolutionary tribunal, on false grounds, with the charge that he had amassed wealth through revenue that belonged to the state. In spite of his selfless devotion to his country, he was sentenced to death on the guillotine.

The day before his conviction, Lavoisier wrote to his cousin, "I have enjoyed a reasonably long and a happy life. I trust that I will be remembered with some regret and perhaps some honour. What more could I ask for? I will be spared of the troubles of old age and shall die with all my senses fully



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receptive. These are probably the last words through my pen"!

The great mathematician Lagrange, a contemporary of Lavoisier, said: "It took but a moment to cut off that head, though a hundred years perhaps will be required to produce another like it."

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The name of Morrison and Boyd invariably sparks the popular canvas achieved by their textbook of organic chemistry. This has been one of the top-rated books sold for generations together. Through its sixth edition, millions of copies of the book have been sold out throughout the world. In fact, the Journal of the American chemical society has cited it as one the great books of chemistry. Dr. Boyd passed away in 2000 and Dr. Morrison in 2010. The popularity of the book was so great that the following anecdote floated through in the world of chemistry.

Once Dr. Morrison was to undergo surgery at a hospital. The surgeon on seeing Dr Morrison greeted him with the words, "Hello Professor Morrison. I was fortunate to be your student and I owe an enormous debt to your textbook that changed my life."

Morrison, taken by surprise, said, "Yes. I think you are my student. Which was the grade achieved by you when you were my student?"

The surgeon said it was 'A' grade. To which Morrison replied gleefully, "If so, then you are qualified to conduct the surgery on me!"

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Creating an Ecosystem for Innovation

India ranks a mediocre 62nd on the global innovation index. We are also just 17th on the list of number of patents granted by the USPTO, the United States Patents and Trademark Office and our performance is poorer than the other BRIC countries. However, the innovation efficiency in the country is high. "There is also a blooming creative industry in India that can be a formidable driver of innovation in the creative industries," said Dr Sam Pitroda at the 'Decade of Innovation: India @Year 1' conference held in New Delhi on the 16th and 17th of November 2011.

Dr Sam Pitroda, Chairman of the National Innovation Council and adviser to the PM On Public Information Infrastructure and Innovations, was here to unveil an innovation framework. In 2010, in an address to the Indian Science Congress, Prime Minister Mr. Manmohan Singh announced the decade 2010-2020 as the 'Decade of Innovation' for India. The National Innovation Council was then formed to create a strategy to encourage innovation and implement it.

As outlined by Dr. Pitroda, the innovation framework seeks to create an ecosystem conducive to innovation by taking several measures. State level innovation councils are being set up and a billion dollar venture fund is being formed with only the seed money being supplied by the government. He also stressed on the need for more schools of design in India, for the industries and institutes of higher learning to collaborate so that innovations would be guided in the directions where most needed and for more investment in R&D.

Reflecting on the challenges that could be faced, Prof. Krishnan from IIM-Bangalore said that there was a need to keep goods affordable yet of high quality, to motivate research, and to have business models that can successfully implement the ideas. The innovation also needs to be sustainable and keep in mind environmental concerns. The Indian economy also needs to generate at least 15 million jobs in the next decade, he said.

Mr. V. K. Gupta, Advisor-CSIR, the leader in innovative work in India, which holds 90% of Indian patents granted to nationally funded Indian organizations, while speaking at the conference said that CSIR will set up eight new innovation complexes, three of which will come up within the next year and permission has been sought for four more. CSIR will also help MSME clusters with technology, scientists and mentorship. MSMEs or micro, small and medium sized enterprises, generate 40% of India's GDP and are a focus area of the framework.

Many inspirational examples were given by the speakers. The HoneyBee network, for example, has been travelling through India to reward innovative ideas of children. Their youngest innovator is a boy of class 1 who thought of shoes that can have vacuum cleaners built into them.

Then there are innovations that have already been put into use commercially. Philips Healthcare designed a CathLab to help diagnose cardiovascular diseases, the highest killer in India. It is available at a much lower price than the previously used imported ones and has been installed in many small town hospitals. It is also being exported now. The Tata Nano is perhaps an example most of us know, of an affordable small car, made in India.

In parts of rural India husk is being used to generate power. This venture also has an innovative business model where instead of installing

Behavioural Problems in Children Born to Pollution-exposed Mothers

A study conducted by the Columbia Center for Children's Environmental Health (CCCEH) and the Institute of Cancer Research in England has found that a mother's exposure to pollutants created by burning fossil fuels may lead to behavioral problems in the child. Children exposed to more of these pollutants showed an increased tendency to suffer from anxiety, depression or attention problems.

To conduct the study, a biological marker (a traceable substance introduced into a body to study it) was used which detects exposure to combustion products. It was seen that the pollutants could travel through the placenta of the mother to the foetus and bind to its DNA. The study is a cause for concern since the behavioral problems will hamper the development of the children. However, these negative effects could be prevented by a shift to more eco-friendly fuel.

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Exciting Year of New Discoveries

In 2011, several new and exciting species of animals were discovered. Let's take a look at some, starting in India. Twelve new species of night frogs were discovered in the Western Ghats. Three more species were rediscovered, one of them hadn't been sighted in more than a hundred years. These frogs are native to India and their habitats have to be conserved to save them from disappearing. Scientists from the University of Delhi, Global Wildlife Conservation and IUCN Amphibian Specialist Group were involved in this research.

While on the subject of frogs, a new species of flying flog has been discovered in Vietnam. It has been dubbed the 'Vampire' flying frog and is endemic to the cloud forests of southern Vietnam. It uses its webbed fingers and toes to glide from tree to tree.

In Australia, a new species of trapdoor spider was discovered. Trapdoor spiders live underground in burrows and jump out when they can sense the presence of prey above. This

Winners of the Thomson Reuters Award with Mr Ashwani Kumar, Minister of State for Planning, Science & Technology & Earth Sciences

electricity meters, where collection of bill payments becomes difficult, they provide enough power to light three bulbs and charge a mobile phone for a month at just Rs. 80.

Some CSIR developed technologies are also going to be put into use by 2012, a visible result of the National Innovation Council and CSIR's decision to jointly promote cluster innovation centres in the country. For example, a technology to coat brass without using cyanide that makes it look brighter will be used in the Moradabad cluster and in the Krishnagiri cluster the shelf lives of mangoes will be increased and the kernels utilized for oil extraction.

Along with the unveiling of the framework and the subsequent discussions, two awards were also given out to recognise innovative talent and excellence. The i3 awards, where i3 stands for India Innovation Initiative, recognises young innovators and helps them commercialize their idea.

This year, the first place went to Mr. Gurmeet Singh for a solar-powered low temperature heat engine. It uses a shape memory alloy to function and can generate energy at night as well. It works at 80-90 C.

Other interesting innovations that made it to the finals included an LED bulb that has a low carbon footprint, is environmentally safer than traditional CFL bulbs and can be manufactured in cottage industries. There was also a mechanism for keeping a patient on a stretcher in horizontal position at all times, even when going up or down stairs, an alternate method to formaldehyde for preserving animal organs and many more. The awards were handed out by Dr. Ashwini Kumar, the Minister of State for Planning, Science and Technology and Earth Sciences.

On this occasion, the Thomson Reuters Innovation awards were also given out to companies and academic institutes based in India. The awards have four categories – Pharma corporate, Pharma academic, Hi-tech corporate and Hi-tech academic. The Thomson Reuters Awards are decided by monitoring patent information. Factors like the size and success of a portfolio and the extent of its globalisation are taken into account.

This year's award in the Pharma category went to Dr. Reddy's Lab in the corporate section and to NIPER, the National Institute of Pharmaceutical Education and Research, in the academic section. The Hi-tech award went to Tata Steel in the corporate category and DRDO, the Defence Research and Development Organisation, in the academic and government category.

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new species has the strange characteristic of having an albino head—a white head with no pigmentation.

A new species of dolphin was also found in Australia. And a cyclops shark was discovered in Mexico. It has one eye in the front of its head, which explains its name.

The California Academy of Sciences found around 300 new species this summer, on a trip to the Philippines. Some of the interesting finds include a cicada which makes a laughing noise, a starfish that eats only sunken wood, a shark that swells up to scare away rival predators and three new creatures of the lobster family that do not have shells but squeeze into crevices when necessary. Many of these species had escaped detection earlier because of their tiny sizes or because they live in areas which haven't been explored much.

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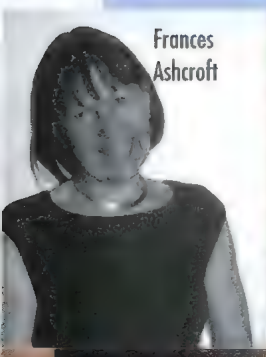
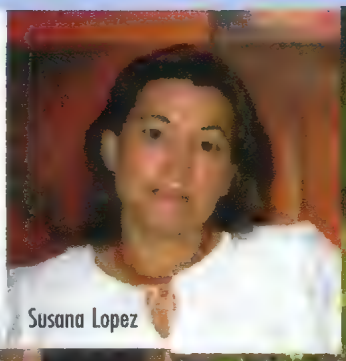
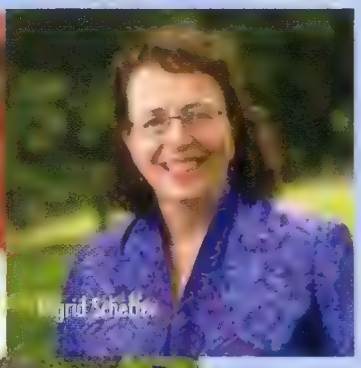
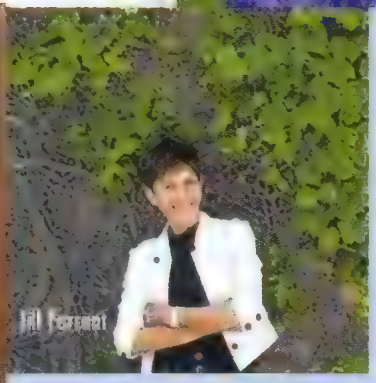
UN & L'OREAL ANNOUNCE WINNERS OF WOMEN IN SCIENCE AWARD

The United Nations and the cosmetics giant L'Oreal have announced the names of five women scientists who will receive the Women in Science award for their advances in scientific research. The award, which is given out each year by the UN Educational, Scientific and Cultural Organization (UNESCO) and L'Oreal, honours five women from different regions of the world who are selected by an independent jury made up of eminent members of the global scientific community.









This year's winners are: Jill Farrant from South Africa, Ingrid Scheffer from Australia, Frances Ashcroft from the United Kingdom, Susana López from Mexico, and Bonnie Bassler from the United States. The awards ceremony will take place on 22 March at the UNESCO Headquarters in Paris, where each laureate will receive $100,000 in recognition for their contribution to the advancement of science.

The contributions of this year's winners cover a wide range of issues. Ms. Farrant, who is research chair at the Department of Molecular and Cell Biology at the University of Cape Town, receives the prize "for discovering how plants survive under dry conditions," while Ms. López, who teaches developmental genetics and molecular physiology at the National University of Cuernavaca in Mexico, will be honoured for identifying how rotaviruses cause the death of 600,000 children each year.

Ms. Ashcroft, who is a research professor at the Department of Physiology, Anatomy and Genetics at Oxford University, will be honoured for her work advancing the understanding of insulin secretion and of neonatal diabetes.

Ms. Scheffer, Chair of Paediatric Neurology and Research at the University of Melbourne, will receive recognition for her work identifying genes involved in some forms of epilepsy.

Ms. Bassler, who is a professor at the Department of Molecular Biology at Princeton University, will be honoured for her work understanding the chemical communication between bacteria.

"The work of the 2012 Award Laureates yielded remarkable insights into human health issues, such as diabetes, brain seizures, bacterial and viral infections, and extending to the cultivation of plants in arid areas," said Günter Blobel, president of the jury and winner of the Nobel Prize in Medicine in 1999.

An international network of nearly 1,000 scientists nominates the candidates for each year's awards, and the winners are chosen based on their work's potential to have a major impact on society. Since 1998, the L'Oreal-UNESCO Women in Science Award in Life Sciences has recognized exceptional women who have helped to "move science forward" with the aim of encouraging women throughout their careers.

MOTHER'S DIET COULD AFFECT BABY'S ALLERGIES

Can the mother's eating habits affect the allergies the baby will be prone to? A recent study conducted by the INRA research Institute in France seems to indicate as much.

The study shows that the polyunsaturated fatty acids or PUFAs in the food of the mother affect the way the baby's gut develops. A certain type of PUFA called n-3PUFA makes the baby's gut more permeable. This enables bacteria to penetrate through the gut into the bloodstream. These unknown substances in the bloodstream trigger the immune system to produce antibodies. The result is a child with a better-developed immune system with less chance of developing allergies.

These PUFAs are found in nut and fish oils and so the changing food habits where corn oils are becoming more popular adversely affect babies. It has also been found that if the mother takes n-3PUFAs during pregnancy, the child is likely to be smarter. Apparently the development of the central nervous system is benefited by these fatty acids. The only catch in this research is that it was conducted on piglets. Although the gut of a pig is quite similar to the gut of a human it is yet to be established whether the findings hold true for humans as well.

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PRAVIN GAWLI

Natural processes have the ability to alter the shape and size of a beach. Human actions further accentuate these changes. But sometimes the solutions could lead to new problems.

Indian Beaches Under Threat!

A visit to the beach can be exhilarating. As you lounge carefree on the beach, soaking in its gorgeous surroundings with waves washing all over, you just wish time could stand still.

Indian beaches attract millions of visitors from far and wide to partake in their aesthetic beauty and recreational facilities lending a helping hand to the tourism industry as well. However, beaches can be dangerous and the hazards can arise due to the morphology and dynamics of the areas near the shore. The effects are manifested in the form of breaking waves, bores, nearshore currents (rip currents) and variable water depth, apart from localized perils such as reefs, rocks and shore platforms.

India has a vast coastline that stretches for over 7500 kilometres and has an average population density of 455 persons per square km along this span. The total area occupied by coastal districts is around 379,610 km^2. It has to be noted that different tectonic, riverine, coastal and wind processes act in tandem to etch out coastal ecosystems that come in different shades and characteristics.

India has one of the most varied coastlines of the world carved out by wind, wave and tidal processes producing dynamic nearshore current systems. The geological setting of beach environment includes hard and soft rock cliffs, embayed coves, open ocean beaches, river mouths, tidal inlets, estuaries, spits and barriers.

Armoring is done by constructing coastal structures to protect the infrastructure. Plans are then executed to reduce beach erosion rates. This is moderation. Restoration is done by beach nourishment.

Coastal erosion is tackled in many ways and the formula adopted for this purpose includes armoring, moderation, restoration, abstention and adaptation.

The beach environment is in constant flux and its shape and size keep on changing due to natural causes or human impacts. Erosion is destroying many beaches whereas deposition in channels and ports is threatening navigation. Manmade structures such as groins (usually built perpendicular to the shore), breakwaters (shore parallel structures) and sea walls (structures built parallel or nearly parallel to the shoreline to separate an eroding land area from the water area) are altering the shape of the beaches and also the dynamics of the water in the area.

Anthropogenic stresses badgering the beaches also include dredging of minerals, sands and gravels; building of barriers to reduce sediment input and output; construction activities for recreation and settlements that leave the coast vulnerable to normal wave action. Sand mining has claimed scores of beaches and there doesn't seem to be any let up in these activities. Sea reclamation for ports and harbours is also increasing the coastal vulnerability to extreme climatic events.

Transport of Sediments

The material that makes up the beach is supplied and/or taken away from it by currents of water near the shore and also long shore currents. These help sculpt coastal landforms. They also aid in the evolution of the coast. Littoral transport is the movement of sediments taking place in the zone near the shore by the action of waves and currents in the form of sediment transport parallel to the shore (alongshore transport) and perpendicular to the shore (onshore-offshore transport).

The onshore-offshore transport primarily depends on wave steepness, sediment size, and beach slope. Studies carried out on long shore sediment transport indicate that the annual gross sediment transport is variable at different beaches. The rate is high along the south Tamil Nadu coast, whereas the zone between Pondicherry and Point Calimere in Tamil Nadu, and the Maharashtra coast experience negligible annual net transport.

The direction of annual net transport along the east coast is towards the north whereas, along the west coast, it is towards the south except in the south Gujarat coast. The distribution and dispersion of turbid waters on the western continental shelf of India reveals that nearshore waters move towards the north. Longshore sediment transport between Ratnagiri and Mangalore is stable over the annual cycle.

The annual net transport direction varies along the west coast showing southerly at Ratnagiri, Tadri and Mangalore and northerly along Vengurla, Goa and Coondapur. Along Maharashtra coast the sediment transport is bi-directional and season dependent, and the resultant sediment transport is southward, whereas for Karnataka the net major sediment transport is southward. Accumulation or removal of sediment on or offshore is carried out by waves and tides. Convergence or reversal of longshore currents is also responsible for this action.

Threat to Beaches

Natural processes have the ability to alter the shape and size of a beach. But, human interference can hasten that activity. Karwar is a compound type of coast (emergent and submergent type) and the amount of erosion during 2000-2003 (3 yrs) was found to be one and a half times more than the net erosion during 1989-2000 (11 yrs). This happened mainly due to human interference in the form of expansion of settlements, development of industries, mining activity, establishment of the Konkan railway, construction of naval base, influence of dams built across Kali River and other interferences. This is apart from the changing weather and coastal processes.

Indian beaches attract millions of visitors from far and wide to partake in their aesthetic beauty and recreational facilities

The protective structures and breakwaters constructed at Mudga, Harwada, Naval base and Karwar harbour are influencing coastal erosion. Accretion is taking place at the central portion of the Arge beach because of artificial nourishment unleashed by construction activity at the naval base. Binge beach is growing centrally due to opposing longshore currents. At Kodar beach the sediment is found to move from one end in an annual cycle mainly due to shifting/ changing of energy heads along the beach owing to wave refraction and seasonal changes in wind, waves and longshore currents. The Kwada beach sediments circulate within the bay (Kwada bay) owing to seasonal variation in the wind and wave regime and also because of wave refraction.

Belekeri is a highly incised bay giving rise to protection of the coast from ma,or wind and wave directions. These characteristics have made it an ideal natural harbour. The Mudga beach along the Belekeri bay had experienced severe erosion in its northern portion prompting the construction of coastal protection wall during 1990-91. At New Mangalore Port the presence of sand accumulation south of the northern breakwater in an otherwise essentially clay domain is suggestive of a net southerly movement of sediment and the possible deflection of currents carrying the sediments by the breakwater.

Along the Mangalore coast severe erosion takes place during SW monsoon periods, whereas from Kapu to Talapady the erosional areas are found to be migratory in character which are influenced by anthropogenic causes like the seawall near Mulur, the construction of breakwaters for New Mangalore Port, and the seawall built at the tip of Bengre resulting in erosion. At Gangavali, near Gokarn the sediment movement is cyclic and seasonal. The prevailing conditions in this beach are ideal for recreational development.

Most of the beaches are mined for sand, but in Kerala they are mined for 'strategic' minerals. These minerals are used in atomic energy and for defence applications. This sand is rich in heavy minerals like monazite, ilmenite, rutile and zircon. But the unfettered mining in Kerala is lowering the shoreline allowing brackish seawater to mix with onshore freshwater bodies devastating the water table and ecology of the area.

Pondicherry faces the brunt of at least a couple of cyclones every year emanating from the Bay of Bengal. Due to severe erosion the entire beach area of Pondicherry was lost even after building of seawalls, which exacerbated after the construction of the Pondicherry harbour. In fact, a restaurant was destroyed after scouring of its foundation took place.

Finding Solutions

Wave and wind patterns, diurnal (daily) and seasonal climatic fluctuations along with the availability of sediments make the hydrodynamical, sedimentological, geomorphological pattern and longshore littoral transport quite variable along the Indian coasts. The movement of sediment is either towards north or south depending upon wave approach direction and configuration of the coast.

Coastal erosion is tackled in many ways and the formula adopted for this purpose includes armoring, moderation, restoration, abstention and adaptation.

Armoring is done by constructing coastal structures to protect the infrastructure. Plans are then executed to reduce beach erosion rates. This is moderation. Restoration is done by beach nourishment, whereas abstention involves non-intervention in controlling erosion. The last stage is adaptation wherein policies are formulated to protect the coastal system. However, armoring has some downward side to it as well.

The physical effects of seawalls and other barriers, in most instances, adversely impact the fronting beach and nearby properties resulting in greater erosion of adjacent areas. Seawalls degrade beaches by passive loss, placement loss and active loss, which has been observed at Pondicherry. To protect its shoreline from erosion, seawalls were built using boulders for a total length of about 7 km. But, in many places along the seawall, erosion occurred due to severe wave action and ground settling.

The Pondicherry port has been constructed by using breakwaters and this encourages progressive sediment deposition at the southern side and erosion at the northern side of the breakwater. After carrying out many feasibility studies, a groin field with artificial sand nourishment has been proposed to replenish the beach.

There is another example. During the 1950s, a wide sandy beach was present at the Tojo coast, Japan, but the coastal forest was artificially expanded very close to the shoreline and a recreational centre was built, resulting in narrowing of the natural sand dune area. On the Maebara coast, located southwest of the Tojo coast, a seawall was constructed very close to the shoreline, resulting in the expansion of the residential area. Detached breakwaters and fishing port breakwaters were built leading to significant shoreline recession. Thus, these coasts became vulnerable against coastal disaster due to man-made activities.

This is of concern in coping with expected sea level rise. The construction of detached breakwaters to protect the coast is seen to induce erosion in the surrounding area. Hence, their usage must be employed ,udiciously.

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REPORT

Training for Young Researchers on "Large Carnivore Ecology and Habitats"

BIBA JASMINE

The absence of top predators appears to lead inexorably to ecosystem simplification accompanied by a rush of extinctions.

John Terborgh et al. in *Continental Conservation*

CARNIVORES are the intelligent mammals that are usually at the top of the food chain. The presence of carnivores thus can be thought of as an index for the presence of their prey species. Hence, they are often referred as an *umbrella species* in the ecosystem.

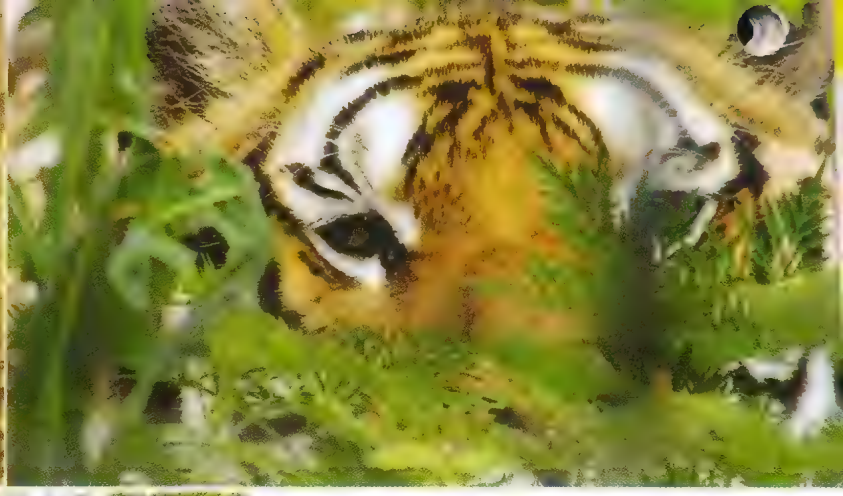
Carnivores are species with broad requirements of resources for their survival, which include those of many other life forms. Identifying umbrella species allows conservationists to stay on the safe side: they may act for the conservation of ecosystems through the conservation of species that require large areas of relatively natural or unaltered habitat for the maintenance of their viable population. Conservation of such umbrella species may indirectly secure the conservation of the entire ecosystem.

Over the years, many of the problems facing conservation have changed quite drastically. In particular, the 20th century has witnessed the development of two largely new traits, an appreciation of wildlife and the explosive growth of the human population, both of which were destined to become increasingly important as the second half of the century progressed.

The soaring demand for food, timber and housing as a result of uncontrolled population growth has led to the destruction of India's natural habitats. Over the past quarter of a century, the very dramatic manner in which wildlife and the natural world has been destroyed or decimated is evident. Even as late as 1945, it was possible to observe large herds of wildlife roaming freely in India's countryside plains and mountainous regions. Fairly large tracts of rich forests sheltered a range of wildlife.

But where has it all gone, and what is being done about the relics that remain? Conservationists must not close their eyes to the alarming threats that exist to the remaining Indian wildlife. Thus, conservation of the top predators is essential. Keeping these dynamics in mind, the weeklong training programme on "Large Carnivore Ecology and Habitats" was shaped.

Vegetation data collection (top left). Shri Shailesh Prasad, Field Director, Dudhwa Tiger Reserve, being felicitated by Dr. Dhariya (below)
Training in progress (bottom right)
Participants taking down notes regarding the scat and sign data collection (bottom left)



Gearing up for the tiger survey routes

Conservation of the top predators is essential. Keeping these dynamics in mind, the weeklong training programme on "Large Carnivore Ecology and Habitats" was shaped.

Exploring the wilderness

Being a student of Biodiversity & Conservation, wildlife has always fascinated me. For many of us wildlife provides powerful images that help define the very essence of our country. There are important emotional and social reasons why humans need to experience wildlife and nature from time to time. We all have to recharge our batteries, to get out and breathe a little fresh air.

But, there is lot more to the wildlife than just personal pleasure. The theme of the training course evoked a simple thought: so much has been said and done for the dwindling large carnivore populations, be it the tiger, leopard, Asiatic lion- –over the years, but does it all have a positive effect on their status? This is still to be examined.

The National Training Programme for Young Researchers on "Conducting Effective Research on Large Carnivore Ecology and Habitats" was held at Dudhwa National Park & Tiger Reserve from October 9th to 15th 2011. The workshop was organized by the Hemchandracharya North Gujarat University, Patan, in partnership with the Smithsonian Institution, Washington DC, USA. The forum gave the participants that extra edge for understanding the challenges faced by the researchers and conservationists in exploring and understanding the carnivore ecology discipline.

The training programme was an outcome of Smithsonian's Training of Trainers (ToT) programme in which the course coordinator and other instructors are trained to build the capacity of young researchers in Tiger Range Countries towards effective research and conservation of tigers, other large carnivores and their habitats.

The one week training course was designed to offer the researchers an opportunity to strengthen their research skills and basic understanding of the broad

Conservationists must not close their eyes to the alarming threats that exist to the remaining Indian wildlife. For many of us wildlife provides powerful images that help define the very essence of our country.

and complex range of global tiger conservation issues through participatory, hands-on classroom and field activities as well as to enhance their personal and professional skill sets for documentation of their valued research. It was geared towards developing effective wildlife information related to the large carnivore in India.

The inaugural session was graced by Shri Shailesh Prasad, Field Director of the Dudhwa National Park and Dr. Hemixa Rao, Vice Chancellor of HNG University, Patan. Dr. Nishith Dharaiya, the Coordinator of the training course, was the real brain behind the course curriculum. Dr. Dharaiya, through his long research experience, was aware of the probable gaps in wildlife research in India and the span of carnivore research in India. The other course instructors were Dr. Faiyaz Khudsar from University of Delhi, Mr. Baburam Lamichhane from Nepal, Ms. Shruti Barve, landscape architect from Mumbai and Mr. Jaidev Dhadhal, a Senior Judicial Officer from Ahmedabad.

The training drew participants from across the nation. The weeklong training touched upon the current status and need of research in the field of wildlife and conservation biology. The session also included fund raising techniques and preparation of research proposal. The first few days of the training dealt with habitat and vegetation survey techniques followed by data entry and analysis. Later, as the participants got a good hold of the theme, the discussions veered towards estimating prey population through recent techniques like distance sampling, sign surveys and designing data sheets for such methods.

There were also some interesting sessions on carnivore feeding ecology, scat analysis techniques and sign data analysis. The participants were also taught how to prepare a manuscript for a research paper. The one thing that I personally kept waiting for was community survey. I particularly feel that understanding the nature of conservation, and more importantly understanding the dynamics that operates behind the science of conservation, is essential to coming up with a useful policy-level response. A deeper understanding of coupled systems undergoing change is essential in this context.

Apart from wildlife science, there was also a session on the understanding of legal issues in context with wildlife and environment protection. It is very essential for researchers to possess knowledge about the laws and policies that can help them in evaluating and questioning the spiky facets of wildlife research from diverse perspectives.

There is a high level of awareness and numerous advocacy groups are striving to project the issue of sustainable development in the national and international arena. It is necessary for us to collaborate with all the stakeholders – the Government, corporate houses, civil society organizations, intelligentsia, media and the common man in our endeavor (small or big) to achieve inclusive sustainable development. Their collective strength coupled with state intervention will definitely prove to be a catalyst in securing development consistent with our policy of environmental protection. And, as rightly put by the course coordinator, Dr. Dharaiya at the workshop, "hope is the rope to success".

The workshop also discussed some potential pathways through which carnivores contribute to ecosystem processes and species diversity. The subtleties of these interactions have strong implications for management strategies of carnivores. Without considering these indirect impacts, shortsighted management strategies to reduce carnivores might cause extensive and long-term changes in ecosystem structure and function.

We face formidable environmental challenges in the 21st century, including unprecedented loss of biodiversity, global climate change, depletion of natural resources, and habitat degradation and destruction. Environmental literacy is critical to becoming an informed and contributing member of today's society. And trainings of such kind will definitely become an effective tool to:

(a) Understand and appreciate the full spectrum of themes and problems dealt within the interdisciplinary field of wildlife conservation

(b) Extrapolate an understanding of conservation related concepts to practical application in the world beyond the classroom

(c) Understand and appreciate the place of wildlife in society and its place in educational programmes

(d) Communicate effectively, both orally and in writing about the problem area.

The conservation movement has not taken root in rural areas and even in the urban areas outside a segment of society. But now, we need to understand that the health of our wildlife is an excellent indication of the health of the environment on which we depend, and that healthy wildlife populations and habitat are important to our social and economic well being.

However, lack of political will, corruption and threats by powerful individuals or corporations greatly hinder the conservation of the large carnivore. Forestry officials are coerced to overlook the regulations and controls over forested areas while the exploitation of natural resources goes unchecked. The increasing capitalist interest in forest and wildlife resources such as forestland, tourism and corporate funding has become an inseparable part of this big game.

Ms Biba Jasmine was one of the participants at the National Training Programme on Large Carnivore Ecology and Habitat at Dudhwa Tiger Reserve. She is presently working with the Delhi Pollution Control Committee, Department of Environment, Govt. of Delhi. Address: E-2/27, Street No-1, Shastri Nagar, Delhi-110052; Email: bibajasmine@gmail.com

A.K. Bakhshi and Vimal Rarh

Chemistry Education in the 21st Century:

Challenges and Opportunities

The year 2011 was celebrated as the *International Year of Chemistry (IYC)*. Many conferences, symposia and workshops were organized all over the world, including India, to highlight the role, importance and achievements of chemistry. When so much is being discussed about chemistry, it would be prudent to have a critical look at the chemistry education system in our country.

CHEMISTRY is an incredibly fascinating field of study. In simplest terms, chemistry is the science of matter and the changes that take place with the matter. Chemists are people who can transform this matter into amazing things. Some chemists work on cures for cancer while others monitor the ozone protecting us from the sun. Still others develop new materials with tailor-made properties, or new textiles to be used in the latest fashions.

It is only through the wonder of the chemical work that it is sometimes possible to convert a fuel into poison, change a colour, render an inedible substance edible and replace a pungent odour with a fragrant one.

A chemist, on any given day, may be studying the mechanism of the recombination of DNA molecules, measuring the amount of insecticide in drinking water, comparing the protein content of meats, developing a new antibiotic, or analyzing a moon rock. To design a synthetic fibre, a life-saving drug, or a space capsule requires knowledge of chemistry. To understand why an autumn leaf turns red, or why a diamond is hard, or why soap gets us clean, requires, first, a basic understanding of chemistry.

Realise it or not, it is a fact that deep down we are all chemists. Every time we light a match, boil an egg or simply breathe in and out, we perform a chemical reaction. Our bodies grow, develop and function entirely as a result of the chemical processes that go on within them. Chemistry is therefore a very fundamental science that impacts all facets of our lives. Thus, studying chemistry is useful in preparing us for the real world.

Chemistry is often referred to as the central science because it ,oins together physics and mathematics, biology and medicine, and the earth and environmental sciences. Knowledge of the nature of chemicals and chemical processes provides insights into a variety of physical and biological phenomena. Knowing something about chemistry is worthwhile because it provides an excellent basis for understanding the physical universe we live in. For better or for worse, everything is chemical!

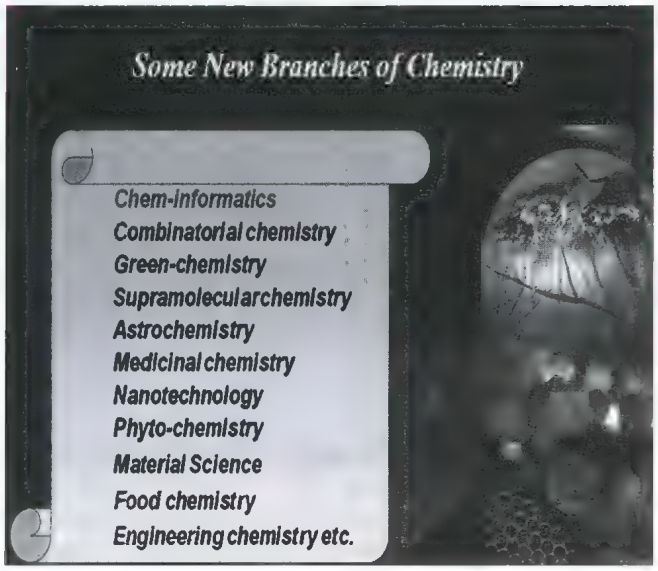
Growth of Chemistry Knowledge

Chemistry is the most productive of all the sciences. It has been growing much faster than, for instance, the world population during the past 100 years. Chemists produce more research papers than all other natural and social sciences together. In 2006, for example, chemists published more than 100 times as many papers as in 1901 when Van't Hoff received the first Chemistry Nobel Prize. The most fascinating aspect of chemistry is that chemists not only describe and explain our world as it is but are also changing and extending this world through producing or making new chemical substances i.e. matter.

Projections of Number of Chemical Substances

Year	*Number of Chemical Substances**
1800	**Some hundreds**
Today	**About 30 million**
2025	**80 million**
2050	**300 million**
2100	**5 billion**

** Assuming the growth rate remains same.*



The result is that there has been an exponential growth in the number of chemical substances. For example, while there were some hundreds of chemical substances in 1800, today we have more than 30 million chemical substances. This number is expected to reach 300 million by the year 2050 and 5 billion by the year 2100.

Even the number of elements in the periodic table, which were 63 in 1869, has now grown to 118. We may be reaching a saturation stage for periodic table but definitely not for the new chemical substances or compounds.

Since each substance has some basic material properties, this has led to the exponential growth of chemical knowledge.

It is, therefore, not surprising that with this unprecedented growth in chemical knowledge, there has been the emergence of many new sub-disciplines of chemistry. These include among others chem-informatics, combinatorial chemistry, supramolecular chemistry, phytochemistry, food chemistry etc.

Difficult to be Up-to-date

The growth of chemistry knowledge is increasing our lack of knowledge. In such a scenario, it has become almost impossible to stay updated in all areas of chemistry. For achieving that, one will have to read about 2000 new publications every day. If one prefers to screen only the short abstracts, one must still read 200 pages/day or about 70000 pages/year.

Since the number of publications increases exponentially, one may also have to double one's reading capacity within the next 15 years. Since nobody is capable of reading all publications of chemistry, not even all publications of a small area, being up-to-date or being universally informed and competent has, therefore, become mere fiction for the past many decades.

There is also pressure on the teacher to finish the syllabus and, therefore, even though a teacher wants his students to acquire an understanding of the subject, it cannot be accomplished

What Ails Chemistry Education?

Chemistry education in a formal sense means the teaching-learning process of chemistry and involves three important components *viz.* curriculum/syllabi, teaching-learning and examination. Further there is a constraint of time within which this whole process has to be completed at each level viz. +2, B.Sc. or M.Sc.

The growth of chemistry knowledge poses a serious challenge for chemistry education because this knowledge should ultimately be integrated with the education system to pass it on to the future generations. There is a need to look critically at each of the three components of chemistry education and see what can be done to achieve the goals of chemistry education in the country.

Syllabi: Chemistry syllabus or the chemistry course content for any level viz., +2, B.Sc. or M.Sc. is like a menu that we offer to the students and should be very carefully formulated keeping in mind the objectives of the course and the background of the students.

In India, science and mathematics education are compulsory up to class X. If one looks at classes IX and X science course structure, one finds that there are five units each in both of these classes besides experimental work. This secondary stage course has been built around six broad themes: Food; Materials; The World of the living; How things work; Moving things, people and ideas and Natural phenomena and resources.

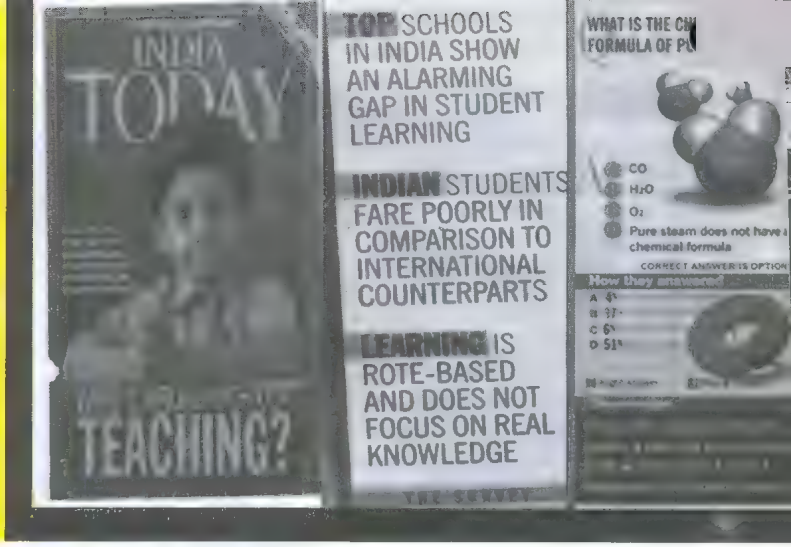
However at +2 level, where chemistry is introduced as a separate discipline for the first time, suddenly chemistry curriculum becomes quite heavy and covers almost all important topics of different branches of chemistry. For example, there are 14 units in Class IX and 16 units in class XII besides experimental work. Now the questions arises: Are all these 30 topics covering all the main branches of chemistry really needed at this level? Is it not too heavy? Do we want to create interest of students in chemistry or want them to run away from chemistry? Further, there is one PGT with specialisation in one branch who teaches all these units. He/she may not be able to do justice with the topics of the remaining branches of chemistry.

For a beginner who is new to the world of chemistry, he should first of all be told about chemistry, its scope, importance and career prospects in chemistry. At class XI, one may have a foundation course of about 6-8 concept-based units covering important concepts of chemistry. In class XII one may have again about 6-8 units in which the applications of those concepts in different branches of chemistry should be discussed.

The examination at 10+2 should cover the course of both classes XI and XII. This will ensure that the concepts of class XI are seriously covered and not left out. Further, since class XII syllabus will be based on the application part of what is learnt at class XI level, both students and teachers would take interest in that. And, since the syllabus would be light, it would be possible to cover all the topics in sufficient depth and generate interest of the students in this discipline. While framing the syllabi it should also be seen that the overloading of the course content with unnecessary factual details is avoided.

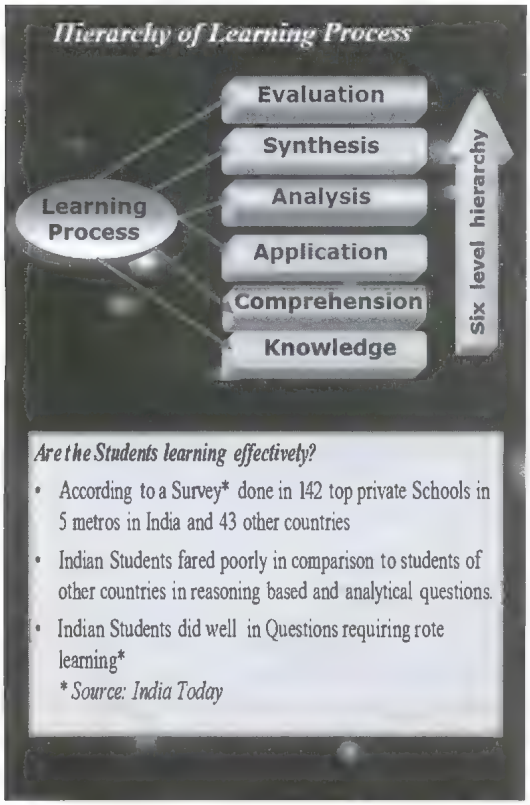
In India, there is no proper coordination between school education and higher education. This is one reason why students are losing interest in science because though school science syllabi are revised regularly every five years by NCERT, the science syllabi at UG/PG levels have not been revised in many universities for more than two decades. Many of the topics that students learn at +2 level are still taught at UG levels and therefore students find all this very boring and monotonous as the course content does not challenge their minds.

Teaching profession will have to be made more attractive. Teachers like researchers should be duly recognized for their contributions in the form of awards.



Teaching- Learning: Once the syllabus has been finalized, the main responsibility to do justice with it rests with the teacher. At 10+2 level, since students are learning chemistry as a separate subject for the first time, it is the prime responsibility of the teacher to ensure that he is able to stimulate the minds of the students and invoke in them an abiding interest in the subject. This can be done if emphasis is laid on the clarity of concepts. If this is not done, the subject of chemistry becomes a phobia for students and they would always be looking for an opportunity to avoid studying it.

A teacher while teaching a particular topic should try to introduce and build it up in a very systematic and logical manner, trying to answer all the questions



that can possibly arise in a student's mind. Once a student finds that all his queries have been answered and that he has achieved clarity of concepts, it will boost his confidence. All this is possible only if the teacher has done a lot of thinking on the subject and has an insight into the intricacies of the subject. Otherwise, the teacher will never be able to do justice in the class.

Teaching should not be for examination only as is presently the case. Rather it should encourage thinking on the subject and nurture innovation and creativity while retaining the excitement of chemistry. A teacher should motivate and inspire students and should ensure that whatsoever he teaches is effectively learnt by the students. Learning does not mean rote learning—rather learning is a six-level hierarchy consisting of: knowledge, comprehension, application, analysis, synthesis and evaluation.

Our examination system should also test all these aspects of learning. If students are trained to learn along these lines from their school days, they are sure to become creative later on. In this way we may not have students with +90% marks but we will certainly have students with an in-depth understanding of the subject and creative minds. What we are facing today is the poverty of such minds as the current examination system emphasizes more on rote learning.

Students too, on their part, should work hard and utilize all their resources effectively if they want to study and learn chemistry. No teacher, no matter how gifted he or she may be, can teach you anything if you are not actively engaged in and responsible for your own learning. It will take persistence, concentration, discipline, patience and lots and lots of practice if you really want to learn chemistry.

Examination: Examination is an important component of education process as it tests the effectiveness of the teaching-learning process. Examination should not test the memory only as is generally the case in most of our examinations. Rather it should test the genuine comprehension of the subject and analytical skills of the students. Once it is done, the students will start laying emphasis on an in-depth understanding of the subject. Changing the nature of questions asked can indirectly and in a cascading manner contribute to strengthening of chemistry education in the country.

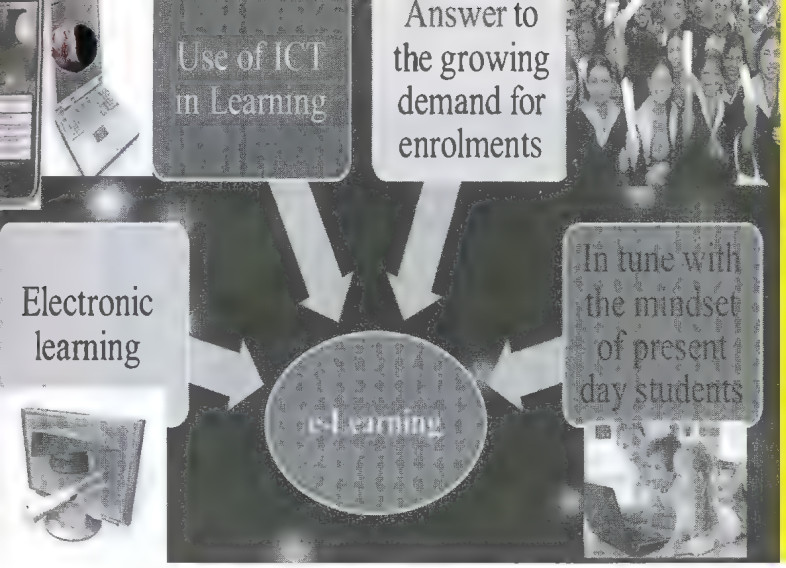
CBSE, for example, introduced Higher Order Thinking Skill (HOTS) questions a few years back and it had the desired result as all schools started laying emphasis on aspects that encourage thinking on the subject.

There must also be a continuous process of assessment rather than the present one-day assessment. Under the present system students are expected to perform very well on the examination day irrespective of everything else. Further, the present day subjective type of testing mostly leads to subjective assessment of students and hence may not be a true measure of the student's competence. Further, due to an increasing number of student enrolments and poor teacher-student ratio, individual feedback of student's performance in a test/assignment by teacher to each student is becoming increasingly difficult.

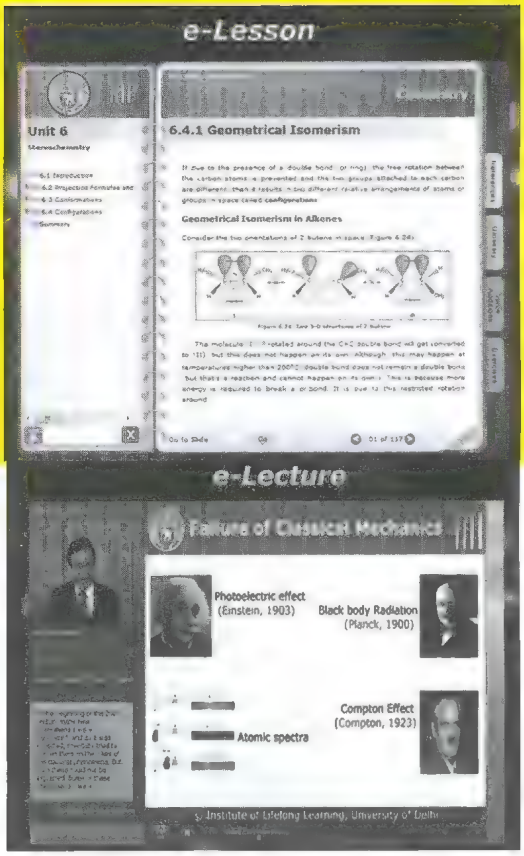
ICT in Education: Need of the Hour

In today's information age, ICT can do wonders that no one can imagine. Look at its impact in various aspects of our life. ICT has fundamentally changed the way we live now. We find a world of difference in the practices and procedures of the various fields such as medicine, travel, tourism, business, banking, engineering etc. as they operate now in comparison to how they operated two decades ago.

The impact of ICT on education, however, has been far less and slow. ICT if used judiciously can prove a big change agent for education. ICT-enabled education is not only an answer to the growing demands for enrolments in education, but is also in tune with the mindset of the present day students and helps meet the challenges of the growth of knowledge.



In simplest terms, chemistry is the science of matter and the changes that take place with the matter. Chemists are people who can transform this matter into amazing things.



ICT, if used creatively, can make a big difference in the way teachers teach and students learn and can help students acquire 21st century skills like digital literacy, innovative thinking, creativity, sound reasoning and effective communication. Integration of ICT with education is therefore very much needed if we really want to create a holistic learning environment focusing on quality, innovation, expansion, excellence and inclusion.

To introduce ICT-enabled education one needs to have high quality multi-media enriched content in different disciplines for various courses including its multilingual conversion, capacity building of teachers and students in ICT skills and state-of-the-art infrastructure along with broadband connectivity for disseminating the content so that it reaches the doorsteps of the learners.

The launch of the *National Mission on Education through ICT* (NMEICT) in 2009 is a ma,or initiative of the Govt. of India with an aim to leverage the potential of ICT in providing high quality personalized and interactive content, free of cost, to all the learners in higher education institutions in *anytime–anywhere* mode.

ICT in Chemistry Education

In chemistry education, ICT can provide solutions to many of the problems afflicting chemistry education and thus help enhance the quality of chemistry education in our country. For example, the regular and more frequent revision of chemistry syllabi is a very big challenge in the university system. The process is very cumbersome and time consuming as it requires going through various statutory bodies besides soliciting the opinion of various sub,ect experts. ICT can be of great help in this regard.

Through emails, discussion forums, video conferencing etc. experts across the country in the specialized field of chemistry can work in a collaborative manner towards regular upgradation and improvement in syllabi. They can also take inputs from industry to make the course up-to-date and relevant to industry so that the students are better employable.

ICT indeed can also play a pivotal role in enhancing the quality of chemistry teaching-learning in the country. Traditional classroom teaching, as we all know, is basically a talk-and-chalk method. Howsoever bright a teacher may be, this method of teaching does have certain limitations in the sense that many complex concepts cannot be well explained ,ust on the board and one does feel that had there been some technological aids, teaching and learning could have been more effective.

Besides, there is also pressure on the teacher to finish the syllabus on time and, therefore, even though a teacher wants his students to acquire an in-depth understanding of the subject, it cannot be accomplished for want of time. Added to this are other factors like heterogeneous group of learners and the poor teacher-student ratio. The result is that the education system in the present form cannot meet the demands of growing needs for quality education.

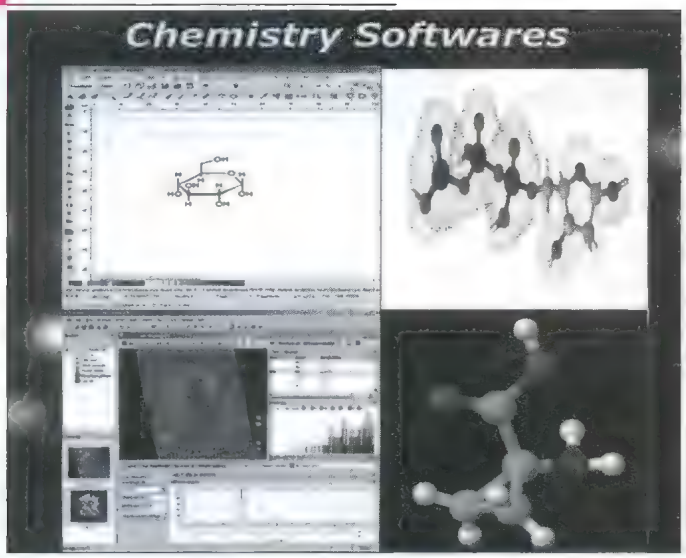
ICT can help in overcoming these limitations by supplementing the present conventional mode of teaching-learning with e learning. To introduce e-learning in chemistry one needs to develop high quality multi-media enriched e-content in chemistry.

This content could be in the form of e-Lessons, e-Quizzes, e-Labs and e-Lectures. While e-Lessons provide quality content with multi-media enriched value additions such as *common misconceptions, points to ponder, interesting facts, did you know?* etc., e-Quizzes in the form of MCQs of different difficulty levels provide the student a mechanism for self-learning and assessment through a complete, logical reasoning of the correct as well as incorrect answers.

The concept of e–Lectures or live lectures enables the best faculty members to reach out to students across the country, thereby not only connecting classrooms but also giving students quality learning material. Multi-media enrichment of e-learning material helps communicate difficult concepts in simpler ways and thus, offers unique advantages in the field of chemistry education. For instance, text alone does not allow learners to visualise the 3D organic molecules to understand their reactions and mechanisms.

Softwares for drawing and visualising 3D chemistry structures, plotting graphs, predicting NMR/UV/IR, interactive periodic table, animations and simulations can enable teachers to provide a way by which learners can understand chemistry in an exciting manner.

In chemistry education in our country, unfortunately, the focus on experimental work is not as much as it should be. Here also ICT can play a very important role.



Some Searchable Electronic Databases of Chemistry

- ***Web of Science including Science Citation Index (SCI)*: A database containing references, many with abstracts, to articles in over 7000 journal titles.**
- ***SciFinder Scholar* (Chemical Abstracts online): This database contains over 25 million literature references, together with 26 million substances.**
- ***Beilstein* contains over 8 million organic compounds together with their associated chemical and physical properties, preparative methods, chemical behaviour and literature references; and a searchable database of some 9 million reactions.**
- ***Gmelin* is an online database giving structural information, properties, preparations, reactions and related literature references for approx. 1.4 million inorganic and organometallic compounds including coordination compounds, glasses and ceramics, alloys and minerals.**

Use of e-labs and virtual labs in chemistry can make the teaching-learning more greener as it can reduce the use of chemicals. Through e-labs, pre-lab study and revision of experiment can be done by students on screen rather than performing the experiment again and again in the lab.

Due to paucity of time and poor teacher-student ratio, frequent and uniform assessment of students is a big challenge. With the help of ICT, examination and assessments can be done more frequently and uniformly with immediate results. Analysis of testing and individualized feedback can be given, so that the weak concepts can be studied again. Online-testing initially no doubt requires large infrastructural investment, but is cost-effective in the long run and can help in meeting the challenge of conducting examinations for a very large number of candidates.

ICT is going to play a very major role in enhancing the quality of chemistry education in the country in the 21st century. ICT-enabled chemistry education has the potential to alter the face of chemistry education in the country by empowering the teaching-learning and examination process.

ICT in Chemistry Research

The exponential growth of chemistry knowledge poses a very serious challenge for researchers in chemistry. A researcher needs to do literature survey of his research field and this task is becoming more and more difficult in view of the fast growing knowledge. There are at present more than 8000 chemistry journals in the world and manually going through even some of them is a very tedious job. ICT has a solution for this challenge in the form of electronic databases. The printed chemistry journals are now slowly losing their significance as primary source of information and their place is now gradually being taken by searchable electronic databases. These are becoming the real source of information in the 21st century and are going to be extremely useful for researchers.

Using the search functions of these databases just by a click of the mouse one can get the relevant information on the screen.

Overhauling Chemistry Education

Chemistry education in the country does not present a very rosy picture. Many factors are responsible for this viz., heavy and sometimes outdated syllabi, focus of teaching-learning and examination on rote learning with little emphasis on in-depth understanding and out of the box thinking and lack of adequate focus on experimental chemistry. No doubt we have had some eminent chemists but whether they are because of the system or in spite of the system is a big question mark.

Chemistry education pedagogy in this country will have to shift its present focus from the examination to the understanding of chemistry, creating interest and nurturing innovation and creativity amongst students. We need chemists who are creative minds rather than rote learners. All this is possible only if the teaching profession at all levels attracts the best talent, retains them and works for their professional development.

For this, the teaching profession will have to be made more attractive. Teachers like researchers should be duly recognized for their contributions in the form of awards, fellowships of Science Academies etc. for their innovation and excellence in teaching.

Prof. A.K. Bakhshi is presently Vice Chancellor of the Uttar Pradesh Rajarshi Tandon Open University (UPRTOU) Allahabad. He has been Head of the Chemistry Department, University of Delhi where he holds the prestigious Sir Shankar Lal Chair of Chemistry since 1996. Professor A.K. Bakhshi has also been the Director of the Institute of Lifelong Learning (ILLL), University of Delhi and the Centre for Professional Development in Higher Education (CPDHE), a UGC Academic Staff College of the University of Delhi during January 2008–December 2010. He was felicitated by the Former President of India Dr. APJ Abdul Kalam for his contributions in the e-transformation of the University of Delhi, as Director ILLL.

Dr Vimal Rarh is Head and Assistant Professor in the Chemistry Department of S.G.T.B. Khalsa College, University of Delhi. As Academic Secretary, ICT at Institute of Lifelong Learning, University of Delhi, and as Incharge for DU e-Learning Portal, she has designed unique ILLL Templates for the e-Learning material hosted on the portal in the form of e-Quizzes, e-Lessons, e-Labs and e-Lectures for all the disciplines.

"Can science & technology help tackle corruption?"

Beyond Science

Let's imagine for a moment that science develops a camera, which catches every single person who exchanges money under the table. If this device is installed in every office, I am sure corruption will take a backseat. But let us not forget, even for a moment, that it's not science that teaches us principles but our moral values that behold us. Science may even one day help bring back the dead alive but let us not be mistaken by thinking that science can eradicate corruption.

I am not by any means questioning the capability of science but there are a few things that are beyond invention and technology. With due respect to every known and unknown scientist, to remove corruption from every nook and cranny of the streets, it's our conscience that is needed and not mere technology.

Karina Sharma, Class 10,
Convent of Jesus and Mary School, karina_india@ymail.com

By Scientific Temper

Science has the ability to tackle any evil existing in this era of science & technology and the most wicked one among these is corruption. It has become very rampant in our society. When scientific temper is inculcated and technology reaches every 'nook and corner', the chaos and disorder will vanish.

The need of the hour is to introduce sophisticated gadgets and

installation of spy cameras in order to trap the polluters of our country. Collecting of fines & tax can happen online so as to ring about transparency in public dealings and offices.

Nancy Asija
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Change in Mentality

If we want to take help of science and technology to prevent corruption then we can take help of CCTV, camera, telephone, mobile phone, satellite etc. But what happens if the persons managing these things are corrupt? Besides, there will many other types of pressure too. So, science and technology alone cannot help tackle corruption unless there is a change in the mental framework.

Sourav Chakraborty
New Alipore College
schakraborty940@gmail.com

Free the Mind of Negativities

Science & technology may be the means for better human life, but not for tackling corruption. Unless the mind becomes purified corruption cannot be tackled. Human conscience acts through the mind, intellect and *sanskars*. So if these three remain burdened with negativity, conscience can never be enriched and be free from evil qualities.

Swapan Rudra
Bankura (W.B.)
drsrudra@yahoo.com

Engineering Human Brain

Science and technology can detect the ways of misuse and malpractices of corrupt persons by its various ultra-modern devices. But all of these devices are handled or operated by man only. Social ethics are secondary to a greedy person. These persons will use the modern technology to equip and improve their own malpractices. Combating corruption can only be possible when the human brain is genetically engineered to remove the basic wild instincts of human nature.

Samyasanghita Ghosh,
Class XI, Gangatikuri A.N. Bidyamandir
Burdwan (W.B.)

Weapon against Corruption

Science and technology can serve as an eagle eye to tackle corruption in India. This assertion was justified recently when technology aided Hazare's crusade by sparking the revolution against corruption not only in Delhi but also in other parts of the country. Telecasts of scams and scandals are other examples. Corruption is prevalent in India. Bribing has become a part of the common man's life, be it civil construction, food supply, recruitment, taxation etc. But, science has enabled quality testing of materials preventing collapsing buildings leading to loss of lives and property. E-governance, e-reservation and e-banking have ensured transparency and execution of operation saving time and money not to miss abating corruption done by government officials. Technology can be expensive but the results are worth it.

Nayanshree Choube
II year, UIT-RGPV, Bhopal
nayan.shree@yahoo.com

Tackle Corrupted Minds to Tackle Corruption

Can science and technology change ones thought and personality? Though sophisticated instruments give valuable information regarding corruption, how much will it be helpful to eradicate corruption? We have to tackle corrupted minds if we have to tackle corruption.

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BJB Autonomous College, Bhubaneswar
bibhutibc@gmail.com

Gadgets & Judiciary

Cases of corruption and many anti-social activities could be brought before the common people and media with the help of CCTV cameras and spy cameras. The monetary transactions could be made fully computerised to keep a check. There could be websites where people could post cases of corruption (along with address) that they come across in their day-to-day life. But still the final verdict is in the hands of the judicial system. It is up to the government and law ministers to frame strict rules and regulations to

control corruption. Rules and punishment should be the same for everybody. And it ultimately depends on the judicial courts how fast and accurate judgment they can deliver to curb corruption.

Sreyasree Mandal
West Bengal.
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Fight Against Corruption

Corruption has become a speed breaker in the development of developing countries. Honest people like Anna Hazare have given a new ray of hope of abolishment of corruption from our country. But he was only able to succeed in his mission due to the electronic media and newspaper. His success was directly linked to the help he got from the electronic media. So, we can say that science and technology can help tackle corruption.

Parth Mahajon
Himachal Pradesh

Beyond Reach of S&T

Corruption is all pervasive in the existing socio-economic structure. It is a monumental task to combat the menace. Now, the question is, could the scientific apparatus come to any help? For me they could not, as corruption is man made and embedded in the mindset. Corruption comes from within and originates in concentration of power and money in the hands of a microscopic minority. How could technology or appliances change one's heart! If a person is determined to adopt corrupt means he could buy even the detractors. We know the popular saying – "A thief has the keys of all locks". So, if one is addicted to corruption, it is a preposterous idea to believe that corruption can be tackled by applying scientific implements. Let us not forget that science and technology are also controlled by man. And in the present society they are forced to serve the interest of the corrupted class in many ways. Therefore, the fundamental question is who owns and controls the technological advancements!

Rajrup Ghosh
Kolkata

Rational Thinking

If the awesome development in science and technology can create designer babies, then surely it can help tackle corruption. Use of high integrated gadgets and security system can do the job. Moreover with the use of science and technology, people should think practically and rationally, that is, they themselves should get rid of corrupt-thinking. Only then they can use the former to a great extent.

Kunal Aich
Ramanuj Gupta Junior College
Silchar, Assam

Science Cannot Tackle Corruption

What is Science? The study or knowledge of the physical and natural world based on observation and experiment. And what is corruption? Willing to act dishonestly in return for money. There is no relation between science and corruption. So science cannot tackle corruption.

Arunaday Roy Barman
Silchar, Assam

Change in Character

I don't think science and technology can help to tackle corruption fully, as corruption has become rooted in our character. To some extent science and technology can contribute to tackling it but human beings are very clever and can easily find their new way out. Because man made machines, machines did not make man. Until and unless a man himself changes his character, abolishing corruption and crime is not possible.

Ashutosh Ganguly
Std 8 , Bhartiya Vidya Bhavan-Nagpur

Cleanse the Mind

Corruption is the flood of money that gushes into the bridge of politics and only caused for the pollution of democracy. Everything in today's world has been modernized by science so, nothing is there that can't be tackled. Corruption can also be fought by the right scientific precautions.

For instance, a national government might build a supercomputer that will store each and every details and important data. The

phone-calls could also be tracked and 'avant-garde' electronic devices can also be applied. But all these will turn into failure if the minds behind these are polluted.

Sayan Chowdhury
Kolkata

Lie Test

Yes, definitely Science & Technology can help us to tackle corruption. It is because of science that the narcoanalysis test has been developed to get criminals behind bars.

Zubair Bangroo
Srinagar

Gadget Traps for Corrupt

Developments in the field of science and technology have gifted us with new techniques for helping the government tackle corruption. We often read in the newspapers and magazines about sting operations. A combination of both sound recorder with video cameras is the most helpful and common gadget useful for stings. All these gadgets or devices are the result of uncountable days of hard work by some genius inventors. Invention of these gadgets has minimized the rate of corruption but due to the rapid increase in population we do not see any change.

Gyan Prakash
S.R.D.A.V Public School, Ranchi

Now write in your thoughts on this topic:

"Is it morally acceptable to experiment on animals to develop products and medicines that benefit human beings?"

Be short, crisp and logical. Send in your photo, if you like.

PURAB PAL

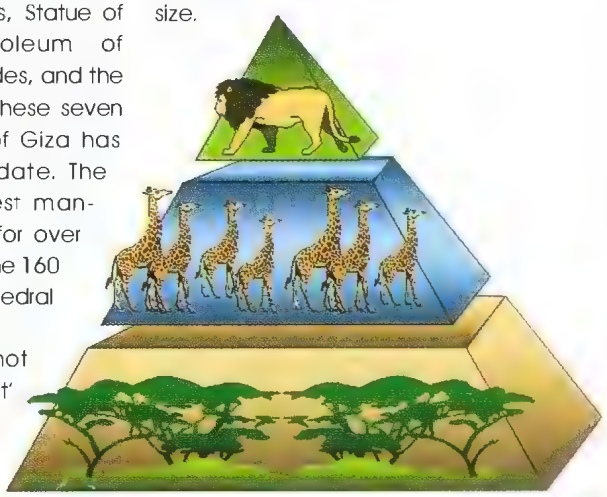
Beauty of the Pyramid

The pyramid shape holds significance in several spheres of life. Here's how.

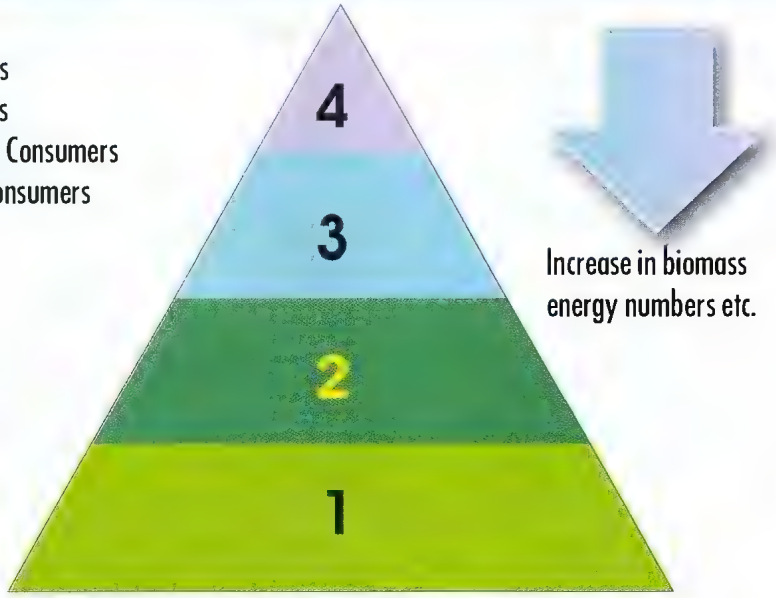
THE great American philosopher, essayist, poet and lecturer of the 19th century Ralph Waldo Emerson once said, "Men love to wonder, and that is the seed of science." Truly, the things that amuse and evoke our curiosity today become the inventions of tomorrow. The wonder and the strong will of humans to unlock mysteries has given birth to all the inventions and discoveries with which we are blessed today.

The word 'wonder' instantly brings to our mind the 'Seven Wonders' of the ancient world. They are the great Pyramid of Giza, Hanging Gardens of Babylon, Temple of Artemis at Ephesus, Statue of Zeus at Olympia, Mausoleum of Halicarnassus, Colossus of Rhodes, and the Lighthouse of Alexandria. Of these seven wonders, only the Pyramid of Giza has remained almost intact till date. The pyramid remained the tallest man-made structure in the world for over 3,800 years, unsurpassed until the 160 metre-tall spire of Lincoln Cathedral was completed in c.1300.

Quite obviously, we cannot apply the 'survival of the fittest' theory to justify this phenomenon, as all of the wonders are non-living things. The other wonders were destroyed during flood, fire, earthquake and other natural calamities and surprisingly only this architecture is still in its original shape and size.



Grass'!	Grasshopper'!	Toad'! Snake'! Hawk'!	Bacteria
Autotroph (Producer)'!	Herbivore (Primary Consumer)'!	Carnivores (Secondary, tertiary, etc. consumers)'!	Decomposers



Moreover, why is the Pyramid of Giza in the list of 'the ancient wonders' while the other pyramids are not? This huge monument consisting of almost 2,300,000 building blocks with each block weighing almost 2.5 tonnes on an average was built in only 23 years, that too long back. Isn't this something worth wondering? A pyramid's design, with the majority of the weight closer to the ground, and with the pyramidion on top means that less material higher up on the pyramid will be pushing down from above. This distribution of weight allowed early civilizations to create stable monumental structures.

But there is something more to this shape called a Pyramid. Egyptians constructed these pyramids as tombs for their pharaohs. They believed that the stars are the gateway to heaven. That is why they designed the specific shape of the tombs so that the dead spirit could easily project itself towards the land of eternity. Of course, there could be no scientific justification to this belief. But the tombs gave us a new shape, the pyramidal structure, and this shape served and shaped almost every field of science largely. Let us try to understand a few of them here.

A very common example is the ecological pyramid or the food chain pyramid. The illustration at the top gives an example of a food chain and the trophic levels represented in it.

Such a path of food consumption is called a Food Chain and each of the levels of food consumption is called a Trophic Level. Interestingly, if we study the biomass, number or energy level of this ecosystem, every time we get a pyramidal structure. The group at the base is the richest one in population, energy, biomass etc. and as the pyramidal structure goes up, these properties also gradually decrease numerically.

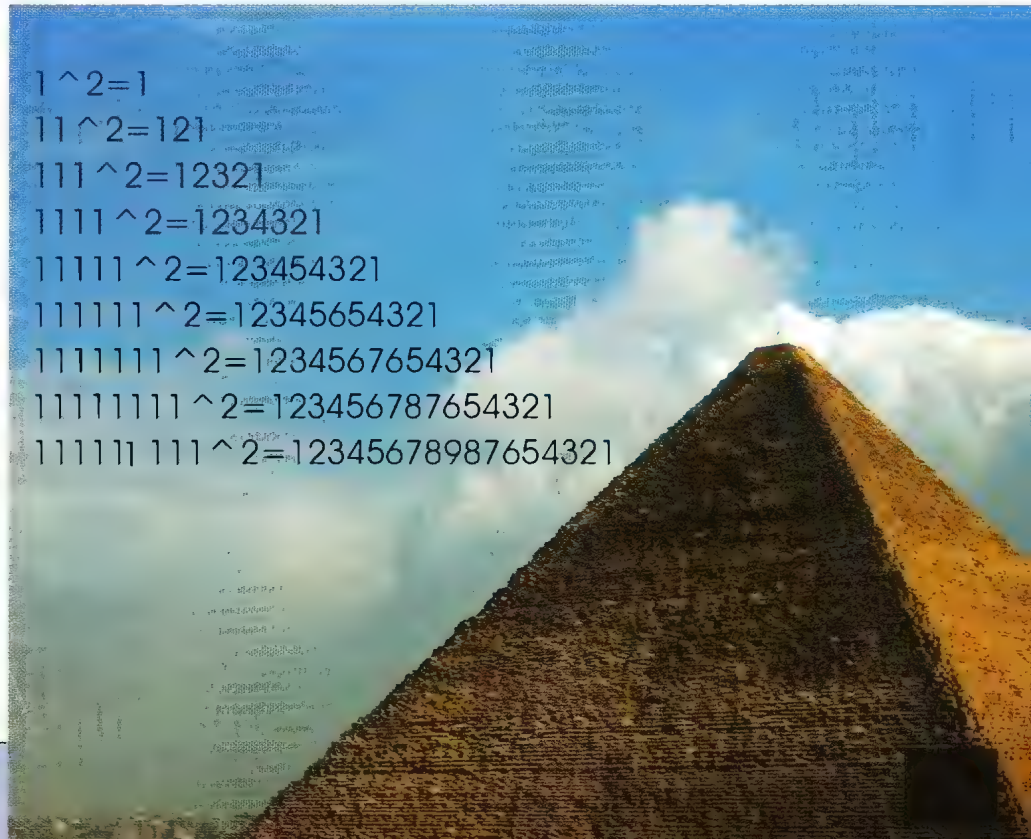
If we study the biomass, number or energy level of this ecosystem, we get a pyramidal structure every time.

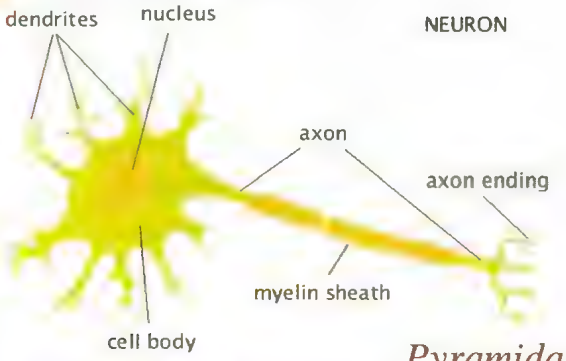
From our real society to the ideal communist model, a pyramidal structure was demonstrated by Marx.

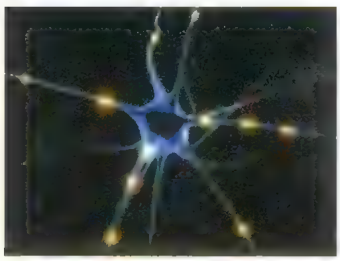
This type of pyramidal structure can be seen in other ecosystems as well. For example, we can consider the ecosystem of a pond. The planktons play the role of the autotrophs there and the other roles are played by several aquatic animals.

This was an example in the biological sciences. In the second half of the nineteenth century, Karl Marx showed us a pyramidal structure in our living society. From our real society to the ideal communist model, a pyramidal structure was demonstrated by Marx.

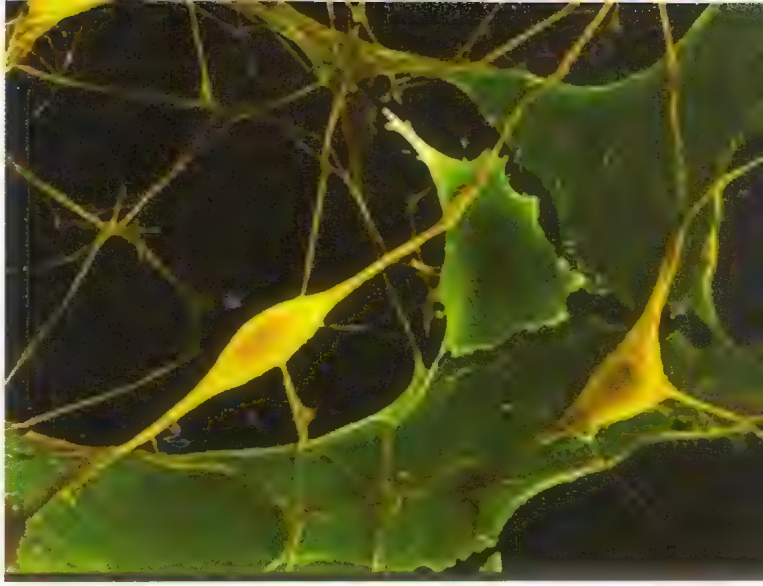
Let's see how the structure can play an interesting role in mathematics. If you ask anyone "what is the square of 1?" he or she may laugh at your question, and many people may actually feel too







Pyramidal neurons in the prefrontal cortex of our brain play an important role in cognitive ability.



The soma and the enclosed nucleus do not play a significant role in the processing of incoming and outgoing data.

insulted to answer such a 'primary school' question. Now ask him the square of 11. The person will take a little time and may answer 121. But if you go on asking the square of 111,1111,11111 etc. he or she will just stand numb and dumb (if the person is not super-smart in mathematics).

Actually, the trick is quite simple. Just count the number of 1s you have in the given number, of which you have been asked to calculate the square, and then simply count 123... till that number and then come back to 1 (just like a countdown). For instance, if you are asked to calculate the square of 11111, then as you notice, there are five 1s in the given number, so you can smartly say the answer is 123454321.

The most interesting fact is if you arrange the square operations of 1,11,111,1111 etc. you can actually obtain a perfect pyramidal structure.

There are many examples of mathematical pyramids and each of them possesses some beautiful characters of some numbers. Here is one more example of such a pyramid, a bit more complex may be, but showing a wonderful character of the number 7.

1*7+1=9-1
12*7+2=98-12
123*7+3=987-123
1234*7+4=9876-1234
12345*7+5=98765-12345
123456*7+6=987654-123456
1234567*7+7=9876543-1234567
12345678*7+8=98765432-12345678
123456789*7+9=987654321-123456789

In biological sciences, 'Evolution' is a very important phenomenon. Simply put, 'Evolution' means the change (anatomical, biochemical and even behavioural) over time in one or more inherited traits found in populations of individuals. Herbert Spencer first used the term 'Survival of the Fittest' as a phrase synonymous with the 'Natural Selection' theory of Charles Darwin as propounded in the *Origin of Species*.

The term is so self-explanatory that even a person not too connected to biological sciences can easily figure out that to survive on this earth one needs to be among the best ones in his class. To be among the fittest ones, quite obviously, adaptation and development are also required along with evolution.

There was a common belief among scientists for a long time that after the basic maturation till the beginning of adulthood, the brain does not show any further significant development. The idea was well established until in the year of 1793 Italian anatomist Michele Vicenzo Malacarne described a simple but smart experiment. He took four adult animals as his specimen, paired them into two groups and trained one of the pairs for years, keeping the other pair untrained. After that, he dissected all of them and found that the cerebellums of the trained pair were larger than the untrained pair.

In 1890, William Jones first proposed this continuous development of brain in his book named *Principles of Psychology*, though it was largely neglected. Later, Polish neurophysiologist Jerzy Konorsky proposed the term 'Neuroplasticity', which means the change in the pre-existing connections between neurons in the brain by conditioning.

Neurons are the core components of the nervous system. They are the structural and functional units of the nervous system. Each neuron is a cell that uses biochemical reactions to receive, process and transmit information. A neuron's dendritic tree is connected to a thousand neighboring neurons. When one of those neurons fire, a positive or negative charge is received by one of the dendrites. The strengths of all the received charges are added together and it is then passed to the soma (cell body).

The soma and the enclosed nucleus do not play a significant role in the processing of incoming and outgoing data. Their primary function is to perform the continuous maintenance required to keep the neuron functional. The firing of nerve impulse is carried out by the axon to the dendrites of the next neuron. This is how the impulse comes out from our central nervous system to the effectors and goes the other way, i.e. from the effectors to the central nervous system.

When buying a computer with definite specifications, you may have observed that its price gradually increases as its data storage capacity increases. Similarly, in higher order animals, as they became more developed, their capacity to store memory starts getting larger. We can also observe variations in memory in different individuals of a definite order of animals, say humans.

Now, where does this extra memory storage capacity come from? We cannot

Pyramid of Cheops

say that a person with a larger memory storage has a bigger head than a person with shorter memory storage capacity. To understand this, let us first try to understand, anatomically what this 'larger memory' actually means. As we have said earlier, neurons are the functional and structural units of the nervous system, thus the portions of the brain that are responsible for the memory are built with billions of neurons too. Now, if we keep the basic working principle of neurons in mind, we can easily understand that to acquire greater memory the neurons in those parts actually need to receive more impulse than other neurons. That is how data is stored in the brain.

This phenomenon was first discovered by Santiago Ramon y Cajal at the turn of the 19th century. He observed that certain neurons in a brain have pyramidal shaped soma and a high number of branching. They were named pyramidal neurons or pyramidal cells because of the shape of their soma. Ramon found these pyramidal cells in cortico-spinal tracts, hippocampus and amygdala inside the medial temporal lobe and he found that all of these portions of the brain were responsible for memory. These cells were not found in places that have no connection with memory. Further studies and research on this topic have made us aware about the functions and larger firing property of these pyramidal neurons.

Pyramidal neurons in the prefrontal cortex of our brain play an important role in cognitive ability. Pyramidal neurons can process many different types of inputs because the prefrontal cortex receives inputs from areas of the brain that are involved in processing all the sensory modalities. Recognising a complex object within the visual processing area of the cortex can be a good example of this case.

The word 'wonder' instantly brings to our mind the 'Seven Wonders' of the ancient world. Of these seven wonders, only the Pyramid of Giza has remained almost intact till date.

So, more the impulse a neuron needs to acquire and store in its body, the more it takes a pyramidal shape. Why did the cells choose to take the pyramidal shape only? If it was only a matter of storing the maximum impulse then it could simply increase its surface area and grow bigger. What was the necessity to change the structure of the cell body?

A thorough experiment has finally given us the answer to this question. A special feature of these pyramidal neurons is that they need to fire an impulse through their axon more rapidly than a natural neuron cell. The nerve impulse we are talking about is nothing but a small electric current in nature. Generally a pyramidal cell can fire in a range of 400 1000 millisecond current pulses while other neurons are much slower. The neurons that are responsible for our memory need to fire impulses very quickly or else we may have to wait longer to recall something—something not at all favorable. This high rate of firing can only be done by virtue of this typical pyramidal shape!

Let us use our pyramidal neurons now and recall what we put down, at the beginning of this article, as the reason for the Egyptians choosing the pyramidal shape for the tombs of their pharaohs. They used to think that such a shape would be better to project the dead souls across the sky. Remember, the time we are talking about is almost 2500 B.C. Those ancient people had a conception in their mind that to project something better we need to have a shape like a pyramid.

They may have utilised this logic in a mystical manner but such a logical and beautiful way of thinking must be appreciated. Especially, when after more than 4000 years we are actually finding that the same logic of projection is being carried by us inside our body, and that the phenomenon is making us fitter than any other animal on this earth. How then can we stop wondering at the ancient wisdom?

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Prize Puzzle

GUESSING GAME

In a fair, a stall owner was challenging visitors to correctly guess the number of balls under the four upturned mugs on the counter in front of him. Each concealed the same number of balls and on each mug was a statement about the number of balls underneath:

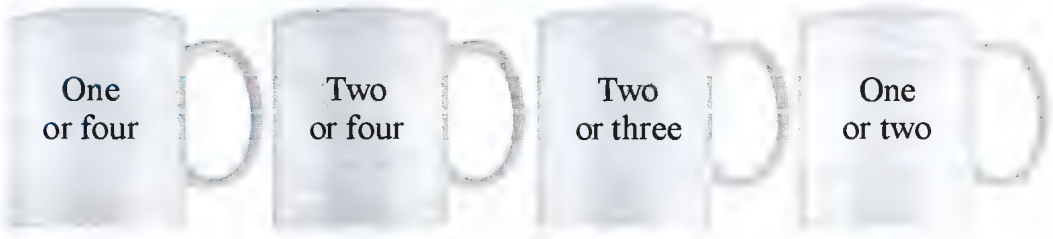
Mug 1: "One or four"

Mug 2: "Two or four"

Mug 3: "Two or three"

Mug 4: "One or two"

Only one of the statements was correct. Can you find out how many balls were under a mug and which statement is true?



ANSWER: .....

There are three prizes of Rs. 500/– each for three correct entries. In case there are a large number of correct entries, the prize winner will be selected through a draw of lots. The decision of the Editor, *Science Reporter*, will be final.

Last date for the entries to reach us: 05-02-2012

Puzzle Corner
Science Reporter
National Institute of Science Communication And
Information Resources, CSIR, Dr. K.S. Krishnan Marg
New Delhi-110012

Your Name : .....

Address : .....

.....

.....Pin Code : .....

Age : .....E-mail :..... .....Sex : .....

Occupation : ☐ Student ☐ Housewife ☐ Teacher ☐ Professional ☐ Retired ☐ Other

Educational Level: ☐ Primary ☐ Secondary ☐ Graduate ☐ Postgraduate

*Please fill up the questionnaire at the back

*Please note: Now you can even send your answers on a photocopy of this page.

UNITS SEARCH

Search for names of 40 physical units. They are arranged horizontally, vertically and backwards.

A	E	I	M	O	H	T	A	F	O	U	A	H	E	I
C	E	S	R	A	P	O	E	D	Y	N	E	U	A	E
I	R	S	S	O	X	U	A	R	E	R	I	O	U	A
E	T	E	I	U	P	W	A	T	T	G	M	O	C	E
U	E	C	P	O	A	D	E	Z	I	I	N	A	A	L
T	M	O	U	O	I	G	R	L	L	O	L	G	N	D
I	A	N	E	A	L	I	B	A	L	E	O	R	D	N
E	D	D	N	U	A	E	P	L	Y	I	E	A	E	A
H	G	I	L	L	R	E	A	M	U	R	N	M	L	C
N	I	O	O	T	U	G	S	A	E	O	U	I	A	O
E	R	G	O	P	U	A	C	N	T	L	E	I	L	U
R	O	U	T	A	T	E	A	E	K	A	I	O	S	L
H	N	O	H	P	U	R	L	P	A	C	E	I	E	O
A	O	O	J	O	U	L	E	E	R	A	E	Y	T	M
F	L	E	H	S	U	B	A	R	T	N	I	P	U	B

Contributed by Dr. S.K. Gurtu, 80/158, Mansarovar, Jaipur-20

SOLUTIONS TO PUZZLES PUBLISHED IN THE NOVEMBER 2011 ISSUE

PRIZE PUZZLE:

ANIMALS & PLANTS SUDOKU

PIG	NEEM	LION	COCONUT	DOG	BANANA	CAT	MANGO	RAT
DOG	BANANA	CAT	LION	RAT	MANGO	PIG	NEEM	COCONUT
MANGO	RAT	COCONUT	PIG	CAT	NEEM	DOG	BANANA	LION
LION	MANGO	NEEM	BANANA	COCONUT	DOG	RAT	PIG	CAT
BANANA	PIG	DOG	CAT	MANGO	RAT	COCONUT	LION	NEEM
COCONUT	CAT	RAT	NEEM	LION	PIG	MANGO	DOG	BANANA
NEEM	DOG	MANGO	RAT	BANANA	CAT	LION	COCONUT	PIG
CAT	LION	PIG	MANGO	NEEM	COCONUT	BANANA	RAT	DOG
RAT	COCONUT	BANANA	DOG	PIG	LION	NEEM	CAT	MANGO

There was an error in one grid of the sudoku, which has been taken into account while screening the winners.

ASTRONOMY PHENOMENA SEARCH

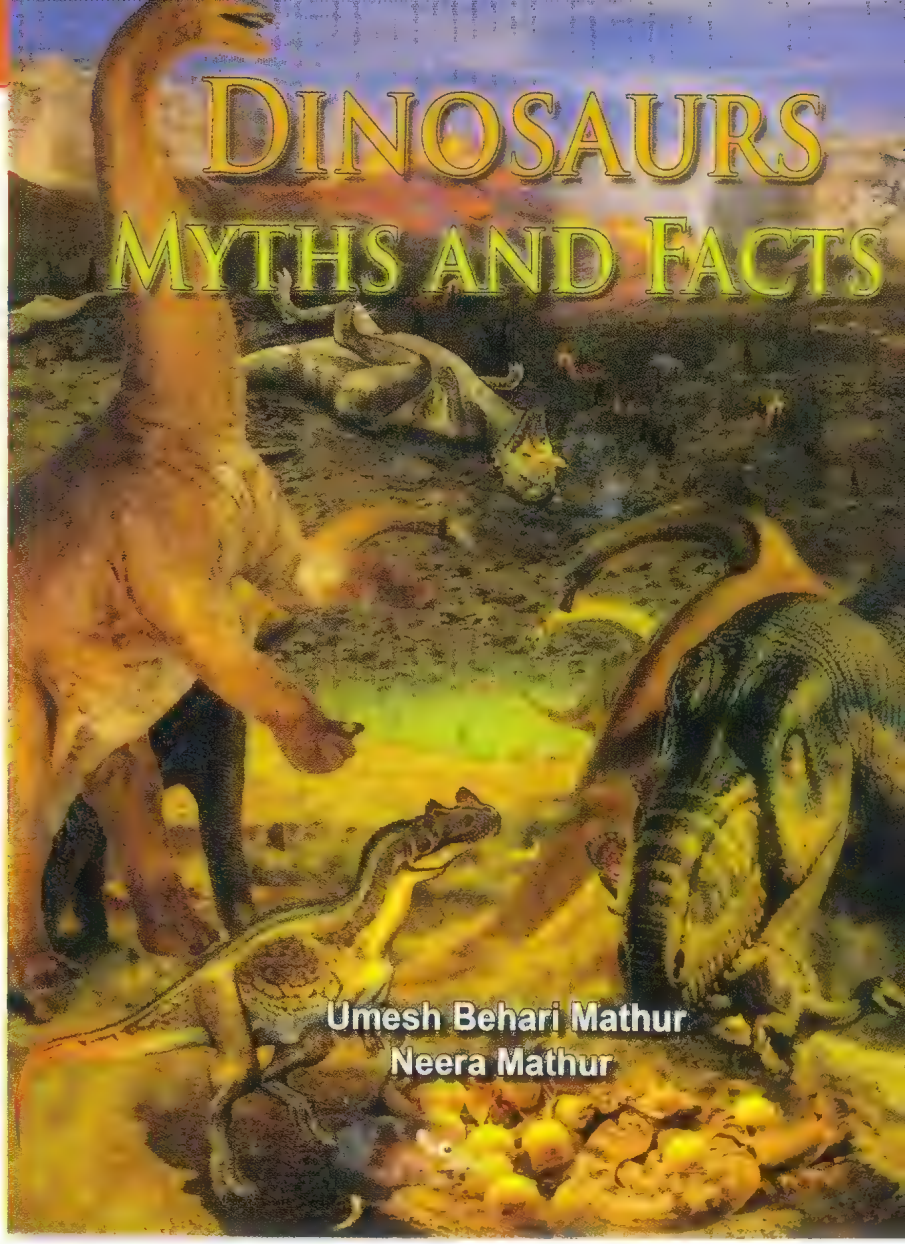
conjunct**ion**, precess**ion**, elongat**ion**, emers**ion**, immersion, insolat**ion**, regress**ion**, culminat**ion**, librat**ion**, opposit**ion**, rotat**ion**, refract**ion**, right ascens**ion**, nutat**ion**, revolut**ion**, reflect**ion**, proper mot**ion**, aberrat**ion**, occultat**ion**, scintillat**ion**.

THE NAMES OF THE PRIZEWINNERS ARE AS FOLLOWS:

1. **Samarpita Paul**, Rabindrapally, Thanapara, PO Chanchal, Dist. Malda, West Bengal-732123
2. **Barbie Hazarika**, C/o Naren Hazarika, Vartak Vihar, Kamar Chuburi, PO Tezpur, Dist. Sonitpur, Assam-784001
3. **Shyam Sagen Hembram**, Union Bank of India, Balasore Branch, Vivekanand Marg,, Dist. Balasore-756001
   Dist. Burdwan, west Bengal-731237

CONGRATULATIONS ALL THE WINNERS!

Dinomania Unplugged



Dinosaurs: Myths and Facts by Umesh Behari Mathur and Neera Mathur, published by Vigyan Prasar, A-50, Institutional Area, Sector-62, Noida-201309, U.P. Ph: 0120-2404430,31,35,36; Email: sales@vigyanprasar.gov.in; Pages 64, Price Rs. 120/-

DINOSAURS, for all that they vanished from Earth before mankind was born, still hold us in their thrall. There is unending fascination with dinosaurs and this fascination is not restricted to just kids who saw *Jurassic Park* with awe. It seems to affect almost everyone. No wonder it is said that dinosaurs are not extinct; they live in our hearts! They also live in our books, in our toys and of course, in TV sets and movie halls too. Reams have been written about dinosaurs and the Internet is full of palaeontology blogs too.

However, there is no end to the curiosity-fuelled questions that children have about dinosaurs. There is also an almost unlimited amount of information available about dinosaurs wherever one looks. The trouble is that it is often difficult to separate where facts end and myths begin. Misinformation abounds.

The book under review is a welcome publication that will help children sift fact from fantasy. Written by a palaeontologist and a university professor, the facts are pretty categorically defined with no scope for the propagation of wrong information. The language is easy to understand; suitable for school children. The style is conversational because the matter is presented in a question and answer format. Since the paragraphs are small, the story skips along making reading an enjoyable experience.

Divided into seven segments such as Anatomy, Extinction, Environment and Food, Physiology and Reproduction etc., plus an Epilogue, the book is indeed a treasure trove of authentic information. Information retrieval is easy too because of the question-answer format. The reader can open the book at random and read a few questions and their answers. For those who know a little about dinosaurs to begin with, there is no strict necessity to read the book chapter-wise. However, the really commendable aspect of this book is its emphasis on dinosaurs in the Indian context. It comes as breath of fresh air because it is perhaps unique in its India-centric approach to a popular science book on dinosaurs. And this is why it should become popular with readers, particularly school children, in India.

Another plus point is that even though the authors are so erudite they have kept a light touch. The poem, *Ode to a Dinosaur* written by Bert Leston Taylor has been placed in juxtaposition with the explanation about dinosaur brains. It is a safe bet that anyone who reads the poem will always see the absurdity behind the belief that some dinosaurs had two brains.

The production value of the publication is good, as it is with most publications from *Vigyan Prasar*. The font is easy on the eye. The colour pictures are adequate, the maps are clearly drawn and the layout pleasing to the eye. However, the single most important addition to the book is the guide to Indian Dinosaur Fossil Parks and Museums along with names, phone number and email addresses of contact persons. This will indeed serve as a valuable resource if schools decide to take students on excursions or if a reader wants some hands-on experience.

Now for some critical comments, howsoever small, because a book so well written, designed and presented deserves to be flawless. In a few places the question jars because it has not been framed properly. For example the question "Did the dinosaurs and snakes eat eggs?" The reader is sure to question why snakes should enter a book on dinosaurs. The question should ideally have been broken up into two questions "Did dinosaurs eat eggs?" "Did any animal prey on dinosaur eggs?" Because that is the information the answer provides. Snakes preyed on dinosaur eggs...that is the reason why snakes slithered into the book under review. There are small errors and oversights of proof-reading that are, at best, only minor irritants. These can easily be rectified in the reprint; and the reviewer has no doubt that the book will surely go into reprint. Several reprints.

Reviewed by Dr Sukanya Datta, Scientist NISCAIR posted to DG's Technical Cell, CSIR HQ. Email: sukanya@csir.res.in

Batting – More Than Just Scoring Runs

G. VENKATESH

WHILE any cricket coaching manual will teach you how to bat, there is no substitute to going out there and doing it yourself. This article restricts itself to what you would not find in most coaching manuals – the physics underlying the basics of batting. Readers with a science/engineering background would appreciate this analysis.

Science in the Art of Batting

Every batting stroke can be tackled as a problem in dynamics and equations can be derived, based on which one can predict possible outcomes. On paper, it will all seem to be very easy when one prescribes limits for associated physical variables such as velocity, inclination of the bat etc. In the fraction of a second that one gets out there to get into position, and stroke the ball, it is expertise gained through concerted practice at the nets, and the instinctual abilities thus obtained, that get results for the batsman.

Having admitted that, dwelling on 'the physics of the matter' will not be a futile exercise and the risk of being dubbed as an armchair analyst can be safely avoided!

The Wristy Strokes

The range of strokes that a batsman can execute is vast, though finite. Two strokes that have captivated numerous cricket lovers around the globe are the leg-glance and the flick (details can be found in conventional cricket coaching manuals). The former is nearly a century old. Vibrant orchestral bells to watch and hear, the two have been the forte of batsmen like Mohammed Azharuddin (India), Greg Chappell (Australia) and Zaheer Abbas (Pakistan). What is more, the aquiline concentration and the feline alacrity that go into the execution of this stroke are unparalleled.

If you are technically inclined and have a penchant for formulae and deductions, here are the why and the how of it all. Refer to Figure 1, which, to a great extent, is self-explanatory. The ball that could ideally be flicked or leg-glanced is encountered by the batsman on or outside his leg stump. This could be a ball that is cutting in from outside the off and moving towards the leg, or a ball that is pitched on the leg and is moving down the leg stump.

The direction in which the batsman moves his bat, is towards the fielding position of Square Leg; and it is of utmost importance that he keeps it as square as possible. In other words, the angle 'A' should ideally be small. If the ball is swinging or cutting away and the angle of deviation from the stump-stump direction is high – greater value of 'B' – the batsman can take advantage of this, by playing the ball squarer towards Long Leg, and a slightly greater value of 'A' in this case will ensure that the ball travels a bit slower towards the fielder, giving enough time for the batsmen to cross over for even two runs.

If the bowler maintains a consistent line just outside the leg stump and is bowling fast, with a Fine Leg stationed down on the boundary line, the batsmen once again, by adjusting 'A' by a well–timed swing of the bat in a direction between Square Leg and Mid-Wicket, can reduce the velocity of the ball slightly, as it moves down to the ropes, and complete a single safely.

From Figure 1, the reader can notice that:

- The greater the value of F_{f2}-F_{f1}, the finer the ball will travel after contacting the bat
- The greater the value of $F_{l1}+F_{l2}$, the squarer the ball will travel after contacting the bat

The direction of swing of the bat the angle 'A', that is, and the speed with which the bat should contact the ball to get the maximum mileage, will depend upon the value of 'B', the position of the fielder behind the wicket whether it is a Fine Leg or a Long Leg, the agility of the fielder,

A right-handed batsman in action

the distance between the batting end and the boundary ropes, etc.

The Defensive Strokes

How to play the forward and the backward defensive strokes can be learnt, as mentioned earlier, from any coaching manual, and most importantly by actually practicing these strokes.

Let us reduce the analysis of the defensive stroke to a collision between two bodies, where one is supposed to resist or impede the forward motion of the other. The resisting body is quite like a wall, which sends a ball thrown against it, ricocheting back. The difference however is that the wall is fixed at both the top and the bottom and cannot move in the direction of impact, while the bat is free to swing back towards the batsman. The challenge that the batsman faces here is to present as rigid a bat as possible while defending the ball, with the grip firm and controlling. Well, when the ball is moving fast, recoil is inevitable, but then, a good defensive stroke minimizes the recoil of the bat, as much as possible.

In the figure, the ball strikes the bat and imparts a force equivalent to $F_{ball\text{-}bat}$ on it. The faster the ball, greater is this force.

Now, this force makes an angle 'B' with the horizontal and can be resolved into its cosine component along the horizontal and sine component along the vertical. The bat resists the ball with a force equal to $F_{bat\text{-}ball}$, which is directed perpendicular to its surface. The bat makes an angle of say 'A' with the vertical. Resolve this force into its cosine and sine components.

From the figure, one can arrive at the following equalities:

- $F_{bat\ ball}$ * cos A resists $F_{ball\text{-}bat}$ * cos B
- $F_{bat\text{-}ball}$ * sin A resists $F_{bat\text{-}ball}$ * sin B

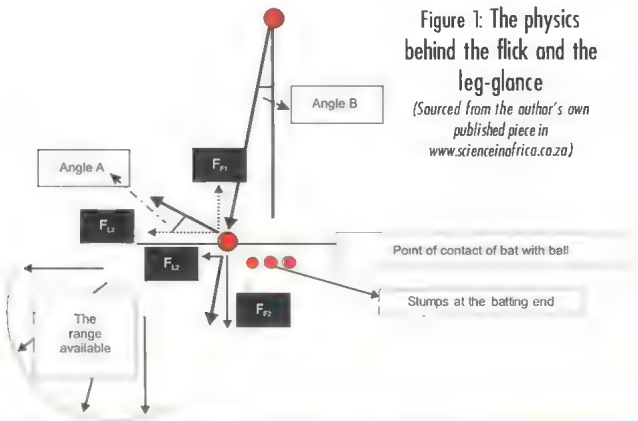


Figure 1: The physics behind the flick and the leg-glance
(Sourced from the author's own published piece in www.scienceinafrica.co.za)

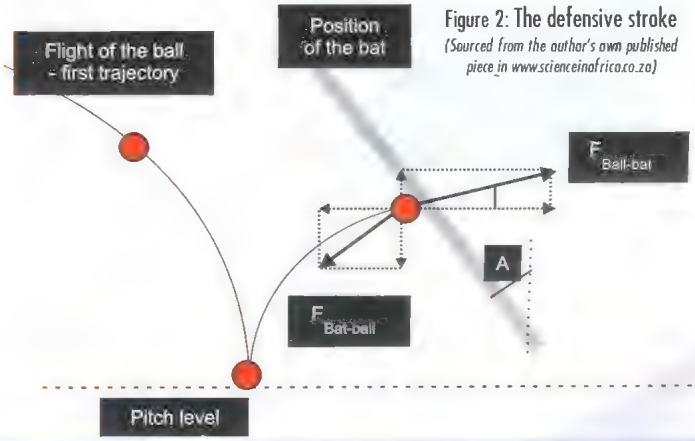


Figure 2: The defensive stroke
(Sourced from the author's own published piece in www.scienceinafrica.co.za)

A ball that turns has a momentum in three directions so to speak – the X, Y and Z. By defending with a straight bat, one can nullify the momentum along two directions – the X and the Y.

Deductions Galore

1. Assume a case when the bat is held loosely and does not resist the momentum of the ball. According to the law of conservation of linear momentum, the bat would have recoiled and the ball would have moved on towards the stumps. The velocity of the ball would have reduced after the impact, but this loss in momentum of the ball would have resulted in a gain in momentum of the bat in the same direction of the ball. Well, this defeats the whole purpose of a defensive stroke!

2. Now consider a case when the batsman stretches well forward to a spin bowler and encounters the ball just as it is taking off after pitching. At this instant, the value of angle 'B' is high and so is the velocity of the ball. On impact, the force exerted in the horizontal direction is going to be lower as this would be directly proportional to the cosine of angle B. The vertical component, therefore, is going to be higher.

Now to effectively resist and bring the ball to rest on the track, the countering force $F_{bat\text{-}ball}$ should have a larger vertical component. This means that the value 'sine of A' will be greater. In other words, the inclination of the bat will have to be more with the vertical, when you are moving well ahead to defend a ball close to where it pitches. Just the right amount of force will arrest the momentum of the ball and bring it to rest soon. However, practically, the force of resistance instead of exactly countering the forward momentum of the ball and making it drop down vertically under the force of gravity, imparts some extra 'positive' energy to it. This results in the defensive prod becoming a 'push'.

However, this is all right as long as the ball is moving along the ground after the defensive prod. In other words, excess of momentum in the upward direction will make the ball pop up and close-in fielders are ever waiting to gobble up those half-chances! Hence, greater the angle 'A', greater will be its sine value and the batsman can rest assured that the ball is not going to be spooned up in the air.

3. Consider a case when the ball is being encountered on the back foot, when it has ascended a bit higher on its upward path after pitching. At this instant, the angle 'B' is substantially smaller as compared to Case 2. A smaller value of 'B' would mean that the horizontal component of the force exerted by the ball would be greater. To counter this, angle 'A' will have to be less. The lesser it is, the more effectively can the backward defence stroke be played.

Ideally, this stroke is played with a perfectly vertical bat. A perfectly vertical bat would mean that 'A' equals zero degree and hence all the resistance offered is utilized to counter the horizontal force of the ball. However, if the ball is still climbing up towards the highest point of its flight, it has a significant vertical component on account of its velocity (though the angle 'B' is small). Here, the bat has to be inclined a bit. This would detract from the horizontal resistance a bit, but then, the batsman rests assured that the ball does not gain height after leaving the bat.

In all these cases, if exactly countered, the ball drops down under the force of gravity, beginning from zero velocity at the top. However, this is rarely the case. Hence, one would find the ball tracing a parabolic descent and landing close to the bat in front of it.

Defending a Spinning Ball

Here, the face of the bat should not be pointing down straight. It should be inclined a bit to the left or right, with its face pointing towards the off side or the on side, depending upon whether one is defending an off-spinning delivery or a leg-spinning one.

In the absence of this inclination, the momentum in the direction of spin is not arrested. Hence, when the ball leaves the bat, it will have some momentum in the direction of turn. An off-spin ball defended without the required tilt of the face towards the off-side, will balloon up to the right of the batsman, and a leggie (colloquial for leg-spinning) improperly defended, will deflect towards Silly Point. Quiet easy to understand.

A ball that turns has a momentum in three directions so to speak - the X, Y and Z. By defending with a straight bat, one can nullify the momentum along two directions – the X and the Y. The momentum in the Z direction owing to the deviation due to the turn on the ball goes un-resisted. That is free momentum now, which the ball retains after the impact. It is thereby free to deflect off the bat and move in the direction of the turn.

When you defend, the bat was either vertical or inclined with the handle leading. Extend the very same principles to an

inclined bat with the handle trailing at the point of impact. What you get is a lofted stroke.

The Lofted Stroke

Now, when you defended you wanted to put the ball down. Hence, the face of the bat was never up in the air. The force the bat exerted on the ball, was directed either parallel to the pitch or it was pointing down at the pitch. Now, you wish to dispatch the ball away. You wish to not just absorb its initial momentum and nullify it, but provide it with enough energy to move in the opposite direction and do so with great speed. You pack it with power!

Here, the bat has kinetic energy when it contacts the bat. Recall that it did not have this when you played the defensive stroke. When you swing the bat and make it impact the ball 'just ahead of the vertical', in front of you, you pack it with punch. The vertical momentum of the ball as it strikes is not arrested. It is compounded by the force exerted by the bat. The horizontal force exerted on the ball by the bat is important here, for to clear the ropes you need range. Height is there by virtue of the fact that you are meeting the ball with a bat inclined with the handle trailing and the ball is ascending as you contact it.

The force of resistance instead of exactly countering the forward momentum of the ball and making it drop down vertically under the force of gravity, imparts some extra 'positive' energy to it.

In this case, once again let 'A' be the angle, the bat makes with the vertical (Refer Figure 3).

Now, let us consider a case when 'A' is zero. The bat makes contact when it is vertical. In this case, the momentum of the ball in the upward direction is not compounded. The ball will have to rely on the existing momentum in the upward direction, for height in its flight. This is what one may term as a 'flat six', if it manages to clear the ropes.

If 'A' is slightly more than zero, the ball when it leaves the bat gets a lot of additional lift. In this case, the horizontal component may reduce slightly, but the vertical one will increase. The resultant velocity may still be the same, and what is more important, the parabola will come closer to being a 45° curve, and this will maximize the range for the given velocity.

Every stroke a batsman plays can be studied in the above fashion, dissected for possibilities under different circumstances! You will read about many of them in coaching manuals – on-drives, cover-drives, pulls, punches, hooks, square-cuts, late-cuts, glances, etc. But, here is a caveat – do not get lost in these nitty-gritties. Go out there, hold the willow, face up to bowlers and learn how to play them.

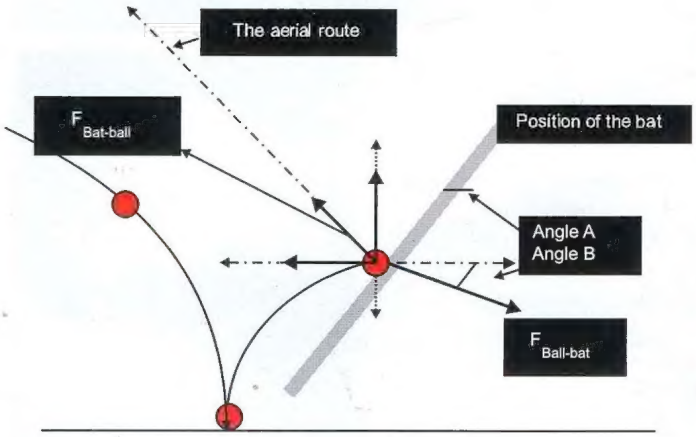


Figure 3: The lofted stroke

(Sourced from the author's own published piece in www.scienceinafrica.co.za)

The direction in which the batsman moves his bat, is towards the fielding position of Square Leg; and it is of utmost importance that he keeps it as square as possible.

Mr G Venkatesh is a Post-doctoral researcher at the Department of Hydraulic and Environmental Engineering in the Norwegian University of Science and Technology, Trondheim, Norway. Address: S/o Shri C. R. Govindarajan, 1:4/F-8/Sector 7, Aishwarya Cooperative Housing Society, Sanpada, New Mumbai–400705, Maharashtra. Email: venkatesh.govindarajan@ntnu.no

FUN QUIZ

TAXONOMY

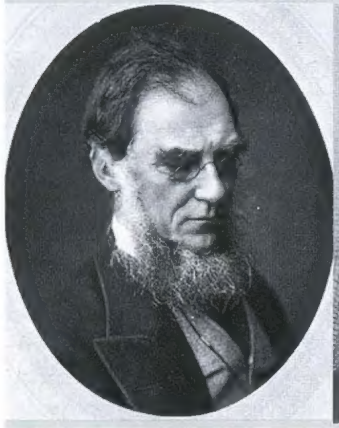
A.K. MONDAL

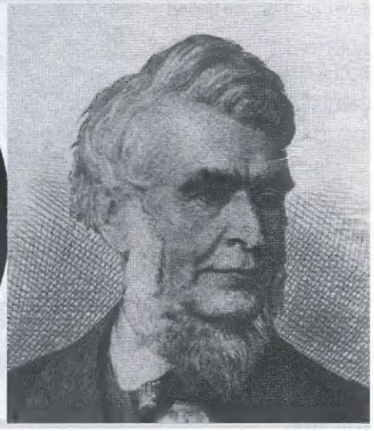
1. Who is the father of Taxonomy?

a) Sir J.D. Hooker
b) C. Linneaus
c) A. Cronquest
d) Charles Darwin

2. Who first proposed artificial system of classification?

a) A. Cronquest b) C. Linnaeus
c) Sir J.D. Hooker & George Bentham
d) J. Hutchinson





3. Who first proposed binomial nomenclature?

a) Sir J.D. Hooker b) J. Hutchinson
c) A. Cronquest d) C. Linnaeus

4. Who is the author of *Species Plantarum*?

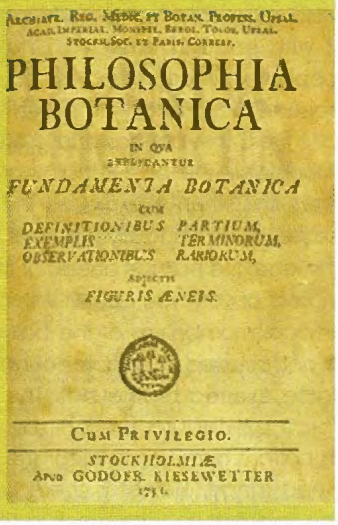
a) J. Hutchinson
b) George Bentham & Sir J.D. Hooker
c) Theophrastus
d) C. Linnaeus

5. Who is the author of *Critica Botanica*?

a) Theophrastus
b) George Bentham & Sir J.D. Hooker
c) C. Linnaeus
d) J. Hutchinson

6. Who is the author of *Philosophia Botanica*?

a) George Bentham & Sir J.D. Hooker
b) C. Linnaeus
c) Theophrastus
d) J. Hutchinson



7. Who is the father of Botany?

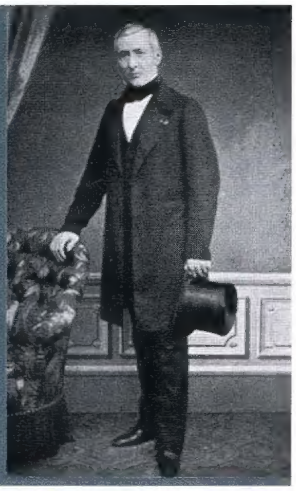
a) Sir J.D. Hooker
b) C. Linnaeus
c) Theophrastus
d) J. Hutchinson

8. Who first proposed the natural system of classification?

a) C. Linnaeus
b) George Bentham & Sir J.D. Hooker
c) Theophrastus
d) J. Hutchinson

9. Who first established the ICBN?

a) C. Linnaeus
b) Alphonse de Candolle
c) Theophrastus
d) A.P. de Candolle



10. Angiosperm appeared in the age of...

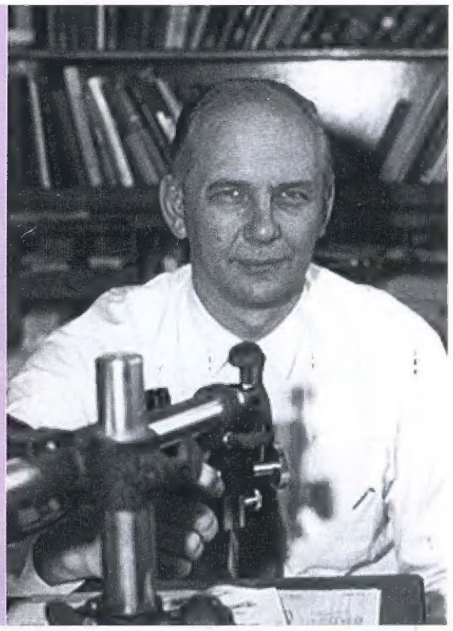
a) Early cretaceous [142 mya]
b) Jurassic [200mya]
c) Triassic [245 mya]

11. Which one is correct?

a) Embryo sac contains 3 antipodal cells, 2 polar nuclei, 2 synergids (cells) and 1 egg cell
b) Embryo sac contains 2 antipodal cells, 3 polar nuclei, 1 synergid (cell) and 2 egg cells
c) Embryo sac contains 1 antipodal cell, 4 polar nuclei, 2 synergids (cells) and 1 egg cells
d) None of the above

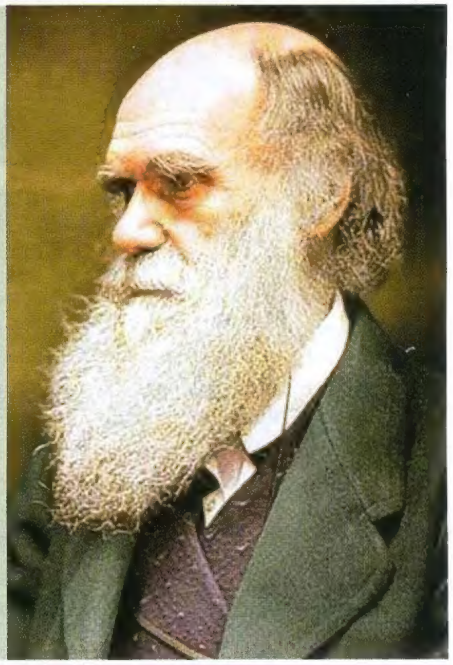
12. Who first proposed the integrated system of plant classification?

a) Sir J.D. Hooker
b) C. Linnaeus
c) A. Cronquest
d) Charles Darwin



13. Who said this: "The origin of angiosperms is still an abominable mystery."

a) Sir J.D. Hooker
b) Charles Darwin
c) J. Ray
d) C. Linnaeus



14. Double fertilization is found in...

a) Gymnosperms
b) Angiosperms
c) Progymnosperms
d) Pteridophytes

ANSWERS:

1. b	2. c	3. d	4. d	5. c	6. b
7. c	8. c	9. b	10. a	11. a	12. c
13. b	14. b				

Contributed by Dr A.K. Mondal, Reader and Head, Plant Taxonomy, Biosystematics and Molecular Taxonomy Laboratory, Department of Botany & Forestry, Vidyasagar University, Midnapore-721 102, West Bengal

Countdown Clock Keeps Track of Important Dates

Countdown Clock allows you to count days, hours, minutes and seconds until important dates, such as birthdays, weddings, lunch, or your next vacation. You easily can load the clock up with your own important dates. There are control buttons that allow you to go through them quickly and select the ones you want to obsess about. You can even program it to display custom messages. It will also count upwards – so you can know how long it's been since you started that diet, or how old your cat is. The clock measures about 3.33 (W) x 3.73 (H) x 3.33 (D) so you can put it just about anywhere you'd like.

Communication Assistance Robot HOSPI-Rimo

As a matter of fact, HOSPI-Rimo is all about helping humans that require assistance and thereby making their lives easier. The HOSPI-Rimo specifically helps those humans who are bedridden or just can't move about. Having HOSPI-Rimo around means that they will be able to talk to the doctor even when he is in a different area of the hospital as if he was in the room talking to you face to face. That goes for family as well. The HOSPI-Rimo also has their medication needs covered since it will deliver medication.

Hot Rod Heated Travel Mug

The mugs in which our coffee comes lose heat far faster than what most of us would like – and toting around a thermos might not look cool at all. Check out the hot rod-heated travel mug that might just make your day even better – you fill it up with your favourite brew, and plug the mug into your vehicle's cigarette lighter. This 12 v outlet will ensure your coffee remains at an optimum temperature all the way through the gnarling rush hour traffic, and you can step into the office with a skip that would make your colleagues wonder just what you put in your coffee.

Electree Solar Bonsai

Real bonsai can be very beautiful and relaxing, but they also require much skill, care and effort. On the other hand, plastic bonsai is easy to use and actually takes care of you. The Electree Solar Bonsai has small solar panels in place of leaves, and instead of roots it has a fairly large battery hidden in its base. The 27 solar panels can be individually adjusted for optimal exposure to sunlight. It's battery has a maximum charge of 13,500 mAh and takes about 36 hours to be fully charged via sunlight.